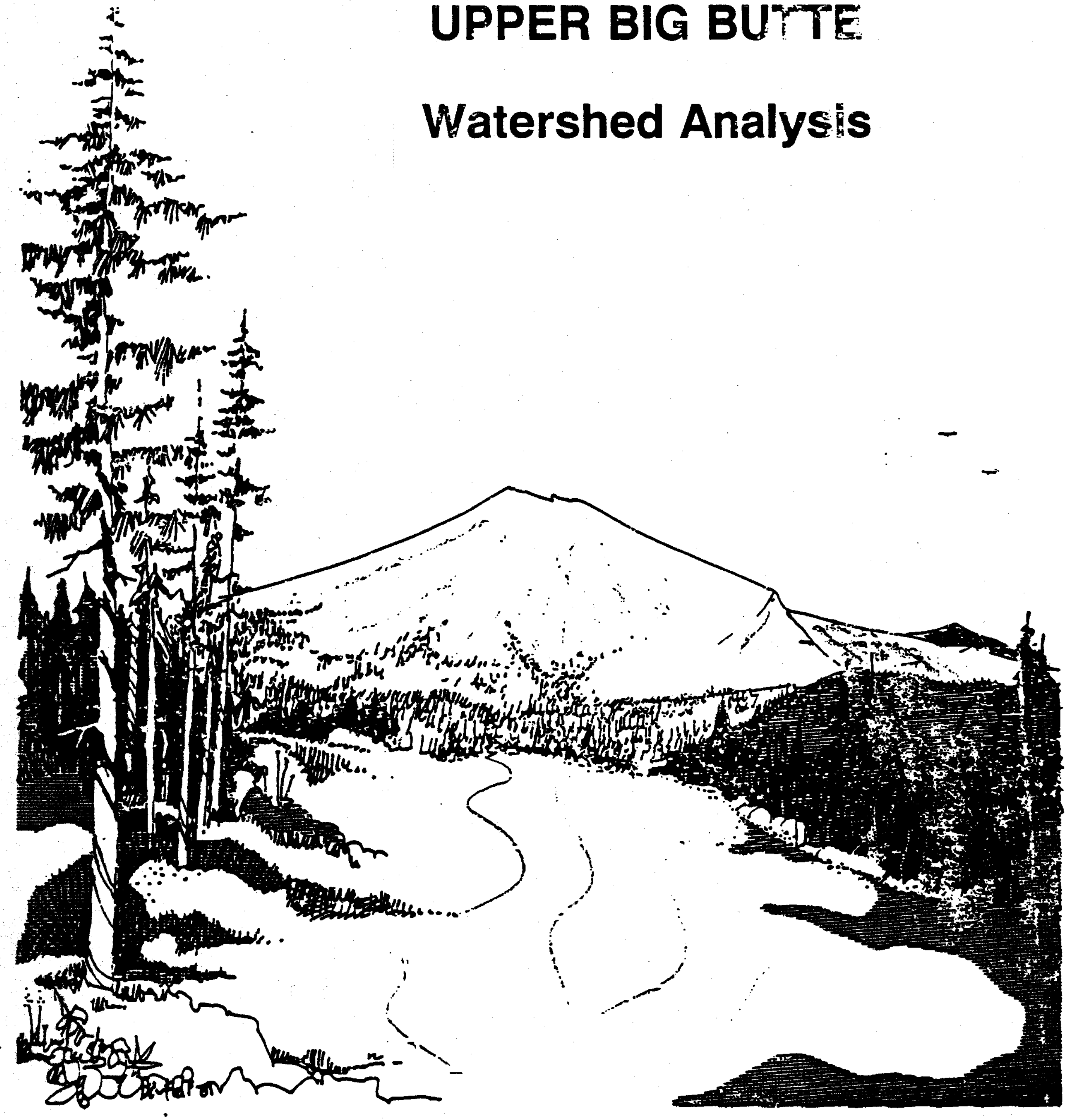
03 PLANS

UPPER BIG BUTTE

Watershed Analysis



Rogue River National Forest

Butte Falls Ranger District

December 1, 1995

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Maps and Charts

CHAPTER 1 - INTRODUCTION

The purpose of watershed analysis is to develop and document a scientifically based understanding of the ecological structures, functions, processes and interactions occurring within a watershed, and to identify desired trends, conditions, and restoration opportunities. The objective of chapter I is to identify the dominant physical, biological, and human processes and features of the Watershed that regulate ecosystem function.

EXECUTIVE SUMMARY AND CONCLUSIONS

The upper portion of Big Butte Watershed has been intensively managed since the 1920's. Timber harvesting and road construction have caused the most significant impacts to the surface character of the Watershed. The Watershed has continued to function well hydrologically. Water quality remains high, stream flows are good, stream channels are in fair to good condition. The Watershed is able to handle storm events without problems, although Willow Creek has the greatest potential for erosion from storm events.

The greatest risk of surface water entering the Big Butte Spring system is in the high infiltration zone where high infiltration rates increase the potential for pollution of the spring system. This highly permeable nature would result in a difficult cleanup in the case of a contamination or spill.

The primary mass-wasting processes in the Watershed are from raveling on steep slopes, earthflows in clay rich soils, and debris slides in or near steep drainages.

The current health of many of the various components of the riparian areas in the Watershed is unknown. Ultimately, the management practices used to protect water quality in the Watershed have been successful. Soil compaction and lack of large woody material are of concern in the Watershed for long term site productivity. A one tree-height riparian reserve width from land management activities should be sufficient width to protect hydrologic values in most streams within the Watershed. Exceptions are in the Willow Creek subwatershed on the Western Cascades geology and in some other locations where there are local instability problems. In those instances, maintain reserve widths of greater than one tree-height.

The Watershed does not include areas of high fire hazard and high fire risk due to generally moderate topography. Prescriptive fire should be used to maintain or improve the health of the ecosystem. Natural plant communities as determined by reference conditions should be restored where possible. Care is needed to maintain and improve site productivity in areas designated for commercial wood production. The demand for forest products will continue to grow and forest management practices will intensify.

Wildlife populations have been significantly altered from reference conditions. Timber harvesting, road construction, water diversion, use of pesticides and human recreational use (hunting in particular) are the major agents of change for wildlife species.

Cattle grazing is another factor influencing the Watershed. Large amounts of suitable range land exist in the Watershed. No negative impacts to water quality or to wildlife have been documented as a result of livestock use. Introduction of European and Asian grass and forb species to enhance forage production has affected the native meadow and forest vegetation. The vegetative characteristics have also changed considerably due to fire suppression. The overall impacts of these changes are not known due to a lack of information on the historic and current status of most species found on the Watershed.

The resources within the Watershed provide excellent recreational opportunities such as camping, fishing, hunting, sightseeing, hiking and boating. The existing transportation system is adequate to meet the current public and administrative needs and resource uses.

Ecosystem health in riparian areas is a function of water flows, natural in-stream debris, pooling, riffles, waterfalls, shade and the full range of aquatic life. There is much to learn about the presence and functioning of these elements in the riparian areas in the Watershed. Despite the greatly altered conditions resulting from past management practices, the water quality and quantity has not been affected at Big Butte Springs.

Key Recommendations:

* Reintroduce fire to maintain stand health and to enhance wildlife forage, reduce fuels hazards, and control stand density.

* Fund an indepth study of the growth and yield projections of managed lands on the Watershed. Invest additional efforts to optimize management objectives, and employ appropriate harvest and reforestation methods including: Carefully conduct harvesting and reforestation practices; control vegetative competition; manage stocking, pests, disease and physical damage to stands.

* Inventory Watershed restoration needs within the Watershed.

* Survey and manage for (FSEIS Appendix J) species to gather information about the species present in the Watershed and insure habitat protection.

* Maintain dispersal habitat for northern spotted owls throughout the area by maintaining fifty percent of the area with at least 40 percent canopy closure of the stand averaging greater than 11 inches DBH.

* Conduct presence/absence studies for wildlife and plant species and monitor wildlife habitat use.

* Gate or berm new roads. Insure existing road closures are maintained year around on the Watershed.

* Update allotment management plans.

* Maintain Forest Plan designated riparian reserve widths of two tree heights on fish bearing streams and one tree height reserves on non-fish bearing streams and wetlands. Adjust reserve widths based on site specific analysis.

* Mitigate soil impacts such as compaction, displacement and channeling by strictly adhering to standards and guidelines.

* Conduct surveys for reptile and amphibian species to determine the extent of populations and habitat.

* Monitor the impacts of all future management activities upon the resources of the Watershed as per the Rogue River National Forest Monitoring Plan.

DESCRIPTION OF THE WATERSHED

There are few areas on the Rogue River National Forest that have been managed as intensively as the Big Butte Creek Watershed. From the early part of this century up to current times, the Watershed has experienced heavy timber harvest, roading, development, and grazing. Yet through all of this activity, the Watershed has continued to provide a reliable source of cold, extremely pure water for the Medford Water Commission and it's 80,000 customers.

The Big Butte Watershed is located near the eastern boundary of the Rogue River National Forest. It includes National Forest land on the Butte Falls Ranger District south of Oak Mountain, north of (essentially) State Highway 140, west of the Cascade crest, and to the western National Forest boundary. The boundaries are commensurate with the boundaries of Big Butte Springs. Included are Bureau of Land Management lands, municipal lands, and private land holdings in a mosaic pattern on the western edge of the Watershed (see vicinity map).

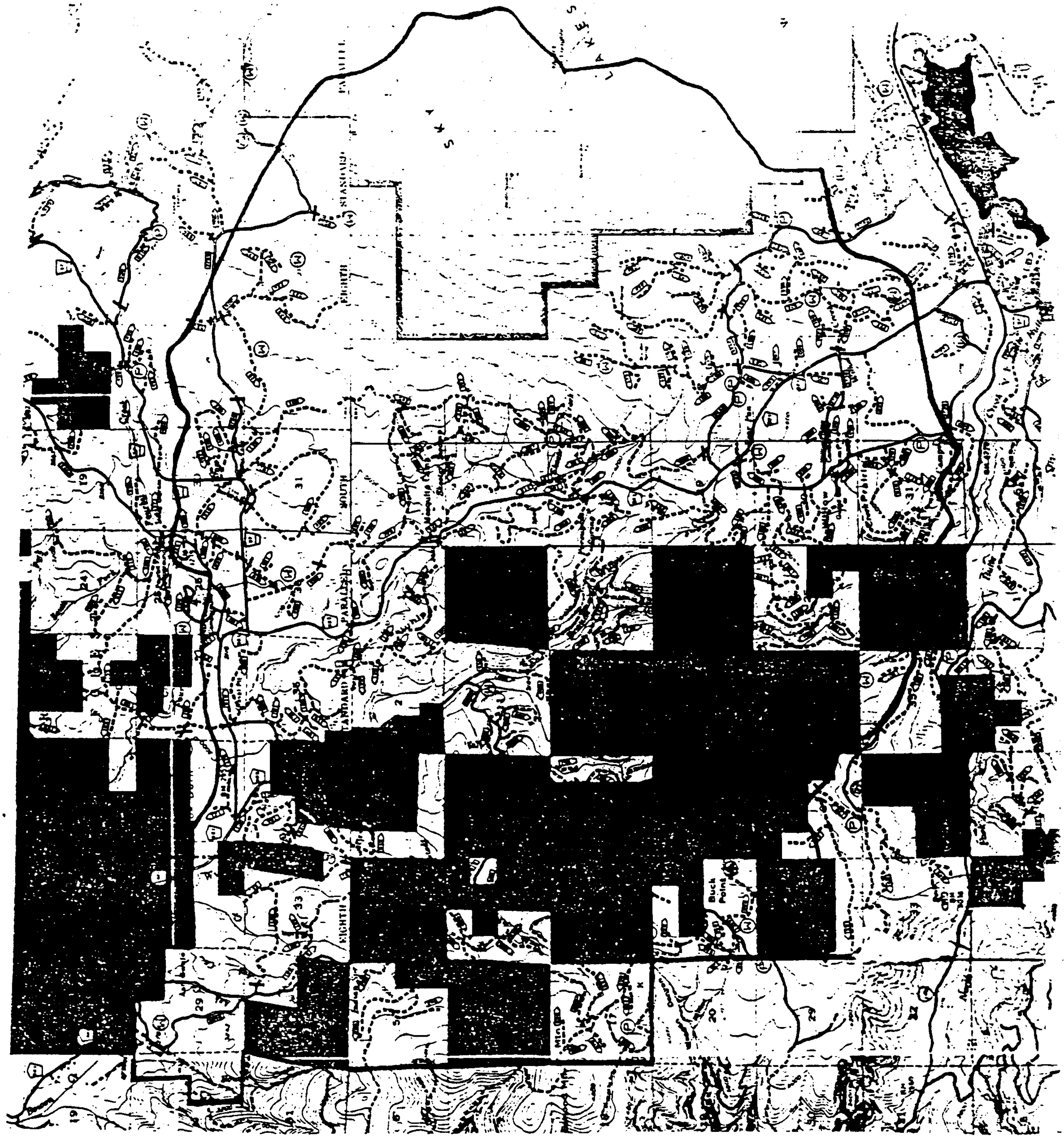
Upper Big Butte Watershed encompasses approximately 56,434 acres. Average elevations begin at about 2700 ft. near Willow Lake, and rise to over 6000 feet at the Cascade crest. Volcanic Mt. McLoughlin (9495 feet) towers above the high Cascades on the east edge of the Watershed. Upper Big Butte Watershed lies within the larger (157,000 acre) Big Butte Watershed. The entire Watershed will be analyzed in three separate analyses: Upper, Center and Lower. This report focuses on the Upper Big Butte Watershed.

The Watershed lies within the 3,300,000 acre Rogue River Basin which flows into the Pacific Ocean. The Rogue River is located in the Klamath and Cascade Mountain physiographic areas. The Basin is approximately 110 miles from east to west. Butte Creek contributes a relatively small proportion of the total water volume of the 210 mile long Rogue River.

The upper portion of the Big Butte Watershed has many uses. Among these are timber, wildlife, recreation, grazing, and water production. One of the most important of these is the production of water for municipal purposes. Big Butte Watershed is the largest municipal watershed in the Rogue River Basin and is the largest ground water source in the basin. It is one of two primary sources of municipal water for Medford, Central Point, Eagle Point, Jacksonville, Phoenix, and seven small water districts. The other source being the Rogue River at ehe filtration plant north west of Medford.

The 26 million gallons per day (MGD) that the springs supply is one of the communities' most valuable and significant resources. Currently, the springs meet the needs of the water district for about seven months of the year. During peak demand of summer, the Commission supplements water from Big Butte Springs with water from the Rogue River.

Vicinity Map
Upper Big Butte Watershed
Figure 1



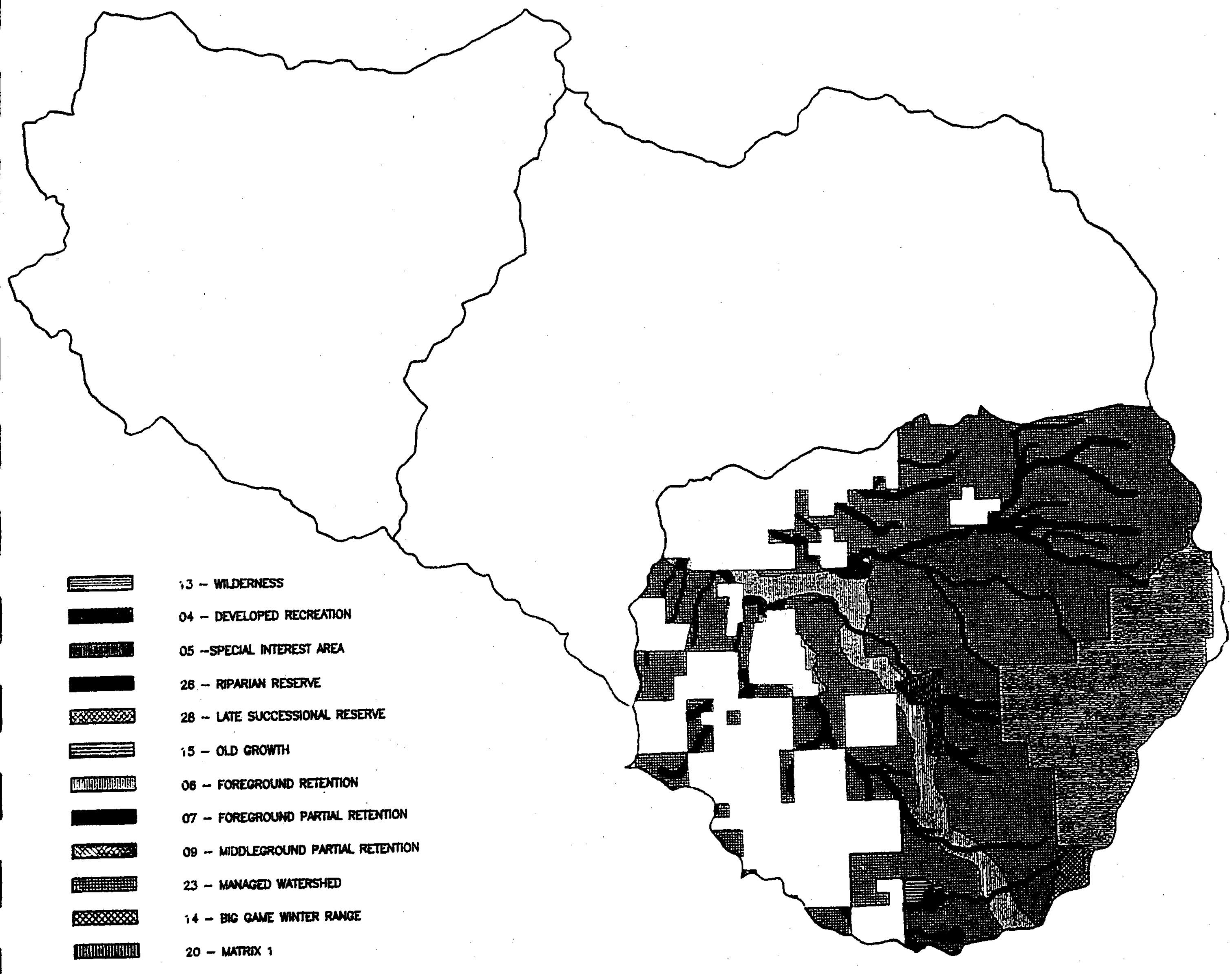
MERGED MANAGEMENT STRATEGIES

MERGED STRATEGY	ATTRIBUTE	ACRES	FOREST PLAN REFERENCE	NORTHWEST FOREST PLAN REFERENCE
DEVELOPED RECREATION	MS 4		Developed Recreation	Administratively Withdrawn
SPECIAL INTEREST AREA	MS 5		Special Interest Area	Administratively Withdrawn
FOREGROUND RETENTION	MS 6		Foreground Retention	Matrix
FOREGROUND PARTIAL RETENTION	MS 7		Foreground Partial Reten-tion	Matrix
MIDDLEGROUND PARTIAL RETENTION	MS 9		Middleground Partial Retention	Matrix
BIG GAME WINTER RANGE	MS 14		Big game Winter Range	Matrix
OLD-GROWTH	MS 15		Old-Growth (Pileated/Pine Marten)	Administratively Withdrawn
MANAGED WATERSHED	MS 23		Managed Watershed	Matrix
RIPARIAN RESERVE	MS 26		Restricted Riparian	Riparian Reserve
LATE-SUCCESSIONAL RESERVE	MS 28		N/A	Late-Succes-sional Reserve
PRIVATE/OTHER LANDS	N/A		N/A	N/A
TOTAL				

Management Strategy Allocations - Merged Plan
Rogue River National Forest Land and Resource Management Plan.

Merged Plan Map of Watershed
Figure 2

MERGED PLAN FOR BIG BUTTE WATERSHED



REGIONAL AND PROVINCIAL PERSPECTIVE

No endangered species are known to reside in the Watershed. Threatened species within the Watershed include the northern spotted owl and bald eagle. The viability of the northern spotted owl remains a major issue in the region. The southern part of the Oregon Cascade Province, (of which this Watershed is a part), is a key habitat link with the Oregon Klamath and Coastal Provinces. The fragmented nature of current forest conditions throughout the Province continues to threaten the recovery of the species. A bald eagle nest site is located near Willow Lake.

Anadromous salmon and steelhead stocks in the Rogue River system have shown decline in recent years. Coho salmon and steelhead are candidates for federal listing as threatened species. Other anadromous runs are not currently listed. The falls at Butte Falls is a barrier to fish passage including anadromous species. The lower portion of Butte Creek, below the falls, is an important anadromous fishery.

Recent surveys of nearby springs and wetlands have discovered several species of previously undescribed snails, indicating the need to survey this area.

Riparian areas within the Watershed have been impacted from past harvest and roading practices. A preponderance of early seral stages, over the last two decades especially, has altered forest and riparian vegetative conditions. The extent of effects that past management activities have had on many aquatic and terrestrial species remains unknown.

HISTORICAL SETTING

Human habitation dates back at least 8000 years. The Klamath, Upper Umpqua, and Takelma are known to have used the area on a transitory basis. Fire was a key element in manipulating vegetation for subsistence hunting by these tribes. European Americans (fur trappers) first reached southwest Oregon in the early 1800's. By the late 1800's agricultural uses and ranching became predominant uses by white settlers. At the conclusion of the Indian Wars, agricultural uses continued to expand. Timber harvesting became a new industry in the area, significantly influencing the development and processes within the Watershed. New harvesting equipment and the completion of the Oregon and California Railroad helped to spur the development of the timber industry. The railroad into the Butte Falls area provided access for both lumber and for human population. With increased human population came the development of roads and domestic and agricultural water uses.

The Cascade Forest Reserve was established in 1893 and took in much of what is now the cascade side of the Rogue River National Forest (RRNF). Human influence greatly increased with the development of the railroad into Butte Falls, and the development of the town and mill at Butte Falls. The 5700 acre Fourbit Creek timber sale was logged between 1925 and 1932. By this time the Public lands were named the Crater National Forest.

The history of Butte Falls began very near the turn of the century. In 1904 the Big Bend Milling Company built the first sawmill at the falls of Butte Creek. In 1906 the first mill was replaced by the Butte Falls Sugar Pine Company's mill. It was at this time that a townsite was created on the flat above and to the west of the falls. On November 10, 1910 the Pacific & Eastern Railway (P & E) concluded construction of the railway to Butte Falls. In 1911 the P&E made its first excursion and freight run to Butte Falls. While these runs continued for several years, the real importance of the P&E was that it provided access to the large body of timber east of Butte Falls.

In 1924, the Fourbit Creek Timber Sale began. It was the first commercial timber sale on the Rogue River National Forest, then called the Crater National Forest. Owen-Oregon Lumber Company (which became the Medford Corp.) took the sale over from the defunct Brownlee-Olds Lumber Company. Nearly 100 million board feet of timber was logged. During this time all snags were felled, heavy tractors were used to skid the timber to the rail locations, and slash was tractor piled. Most of the standing timber was removed. All of the 5700 acres logged are within the boundary of the Watershed.

Another 7000 acres of logged-off private timberland in the Watershed was traded to Forest Service Administration between 1928 and 1934 in exchange for stumpage on Fourbit Creek Timber Sale. Many of these acres are near Willow Lake and near Whiskey Springs. This land exchange helped shape the present boundaries of the Forest.

In 1910, the Cat Hill Burn, an intense, stand replacement fire, charred 30,000 acres in the Watershed near the crest of the Cascade Range.

During and after World War II, additional influx of people into the region and extraction of commodities occurred. Forest products and water were the main commodities. Water developments had major affects on hydrologic and aquatic processes.

CLIMATE

Much of the Cascade Range has been influenced by previous ice ages. Glaciers and volcanic activity had significant influence on the landforms within the Watershed. Mt. McLoughlin was 1,000 feet taller before being eroded by glaciers. The climate since the last ice age has been temperate and humid with a general cooling trend masked by cyclical cooling and heating periods lasting a century on average. The climate in the Watershed currently can be described as Mediterranean, with generally mild, wet winters and warm, dry summers. Annual precipitation ranges from 40 inches in the lower elevations to approximately 80 inches on the upper slopes of Mt. McLoughlin and High Cascades. Precipitation generally occurs as rainfall at the lower elevations. Snow is the predominant form of precipitation at the higher elevations. Most (70%) of the precipitation occurs from November to March. In the past decade, the area has experienced droughty conditions. Shortage of rainfall has shown up in decreased streamflows in the surface water streams in the Watershed but only a slignt decrease in the flow from Big Butte Springs.

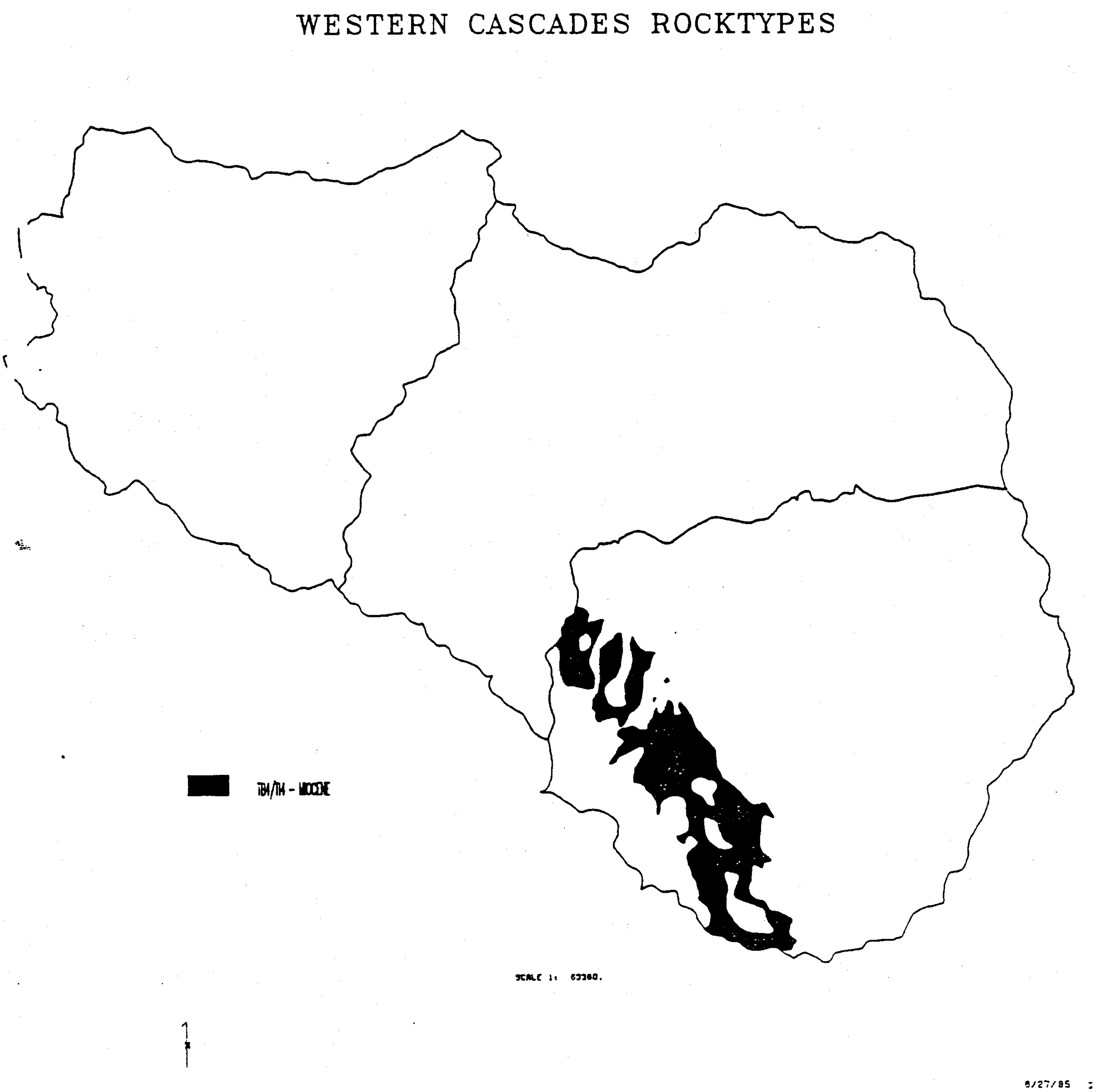
GEOLOGY

Big Butte Watershed can be stratified into two geologic provinces. The "softer" Western Cascade Range erupted 38 to 17 million years ago, and the "harder" High Cascade Range started erupting 7 million years ago. Though both provinces are volcanic in nature, their physical characteristics and response to forest management are very different.

The Western Cascades Geologic Province (Western Cascade Range) makes up the western two-thirds of the entire Big Butte Watershed. In the Upper Big Butte Watershed, the Western Cascades terrain occurs as islands of land surrounded by High Cascades terrain (see map on following page). Sixty percent of these rocks are pyroclastics, which easily weather to clay-rich soils. The rocks are soft and often highly weathered. Slopes are often steep and soils are highly erosive. The Western Cascades terrain is the most unstable rock type on this Watershed, with respect to slope stability.

Geologic Provence Map

Upper Big Butte Watershed
Figure 3



The High Cascades Geologic Province (High Cascade Range) occupies the area east of the Western Cascades. It consists of two distinct types and time periods of volcanic eruptions; shield volcanos, which erupted basalt lava seven to three million years ago, and composite volcanos, which started erupting andesite lava three million years ago. The base of the High Cascades rests upon the Western Cascades and is built up from a chain of broad, overlapping shield volcanos.

About three million years ago the type of erupted-lava changed from basalt to andesite. Unlike the very liquid basalt lava of shield volcanos, which builds broad, slightly domed shield volcanos, andesite lava of composite volcanos is much thicker and built into prominent peaks like that of Mt McLoughlin. Mt. McLoughlin is a composite volcano built on top of an older shield volcano. Composite volcanos are capable of erupting again.

NATURAL RESOURCES

The geologic and hydrologic features of the Watershed are significant and result in high quality water at Big Butte Springs. The high quality water has been a major influence in the development of the landscape since the early 1900's.

Throughout the 20th century, growing population and agricultural uses, including grazing, have brought increased pressure on local resources, including wildlife. In addition to big game hunting and fur trapping, for sport and subsistence, anti-predator campaigns eliminated wolves from the Watershed and greatly reduced cougar and coyote populations.

Following the Depression and World War II, early seral conditions increased as old growth stands were logged (Fourbit Creek Timber Sale and private timber company logging). Species that thrive on edge and younger forest conditions found more habitat available. Species which favor a closed forest condition or old growth have lost habitat rapidly over the recent four decades.

Upper Big Butte Watershed consists of true fir-hemlock and mixed conifer forests. Mixed conifer forests include broadleaf shrubs and hardwoods in the understory. Mixed conifer forests occur on drier sites and at lower elevations. The true fir-hemlock forests occur at the higher elevations on mid and upper slopes. Climate is cool and wet; snowpack is present up to 8 months each year.

Altered forest conditions have resulted in the loss of natural survival mechanisms against fire, insects and disease. Given enough time, and without major disturbances, mountain hemlock and white fir will replace Douglas-fir and western white pine in the true fir-hemlock stands; western hemlock, white fir and incense cedar will replace Douglas-fir, sugar pine and ponderosa pine in the mixed conifer stands.

The water in this Watershed is cold and clear during summer months allowing for good downstream fisheries. The growth and production of fish within the Upper Big Butte Watershed is low due to the somewhat sterile conditions and cold water temperatures. The streams maintain high clarity during the winter months. The Upper Big Butte Watershed is not an anadromous fishery. Native species are primarily native cutthroat and rainbow trout. Eastern brook trout were introduced in the early 1900's in various lakes and streams in the greater Rogue Basin and are present in the Watershed.

Most of the soils are derived from the volcanic rocks of Mt. McLoughlin. Soils are shallow, limited in water holding capacity, and are droughty during the dry summer months. Soils in the Willow Creek drainage are higher in clay content and have a greater water holding capability.

Historical accounts regarding wildlife are limited to journals of early settlers. Several species now extirpated from the Watershed were described such as gray wolves, grizzly bear and lynx. The forest was described as being almost completely untouched with large sugar pines and Douglas-fir.

The presence of fire was also noted. The Watershed is not in a high hazard category for wildfire due to generally moderate topography. However, a catastrophic stand replacement fire could occur if the right conditions exist.

Harvesting, management of forage for wildlife, and grazing in the Watershed has caused changes in the native plant composition. Introduction of non-native species for erosion control has also influenced this occurrence. Although no overgrazing problems exist, grazing has had an influence on the amount and distribution of native species in the Watershed.

Insects and diseases are responsible for large and small scale changes in vegetative composition, stocking, and structure in stands of the Upper Big Butte Watershed. Their activities are expected to continue to increase due to dense stocking, past harvest activity, multi-layered canopies, extended drought conditions, and higher proportions of species prone to root diseases and stem decay resulting from fire exclusion.

CHAPTER 2 - KEY QUESTIONS

The following key questions will focus the analysis on particular issues and relationships that are of interest or concern for the analysis area. The key questions relate to key ecosystem components, processes and uses in the watershed.

TERRESTRIAL SYSTEMS

I. Vegetation:

a. What is the current vegetation and stand condition within the watershed?

b. What special habitats, exotic and non-native species, and locally rare and endemic species are present in the watershed?

II. WILDLIFE

a. What wildlife species inhabit the watershed and what processes affect their welfare?

b. What wildlife species recognized as in peril (T,E & S) are present in the watershed and how does the watershed provide habitat for those species relative to their entire range?

III. LANDSCAPE PATTERNS

a. How does the geology of the watershed influence other elements such as water quality (sediment delivery to aquatic habitats) and presence of special habitats (cliffs, seeps, etc.) in the watershed?

b. How have the geology and natural processes in the watershed affected the status of soils and soil productivity?

c. What historical disturbance and natural processes (grazing, harvesting, roading, fire, geologic processes, insects and disease) and what effects on (species, vegetative structure changes, compaction, sedimentation) these processes have occurred?

d. How is the current landscape pattern different than would be expected under the natural disturbance regime?

AQUATIC SYSTEMS

IV. WATER QUALITY

a. Is there evidence of reduced water quality in the watershed and what types of water quality impacts are associated with activities in the watershed?

V. AQUATIC SPECIES, HABITAT AND POPULATIONS

a. What is the historical and current habitat condition, life history, populations and distribution of fish and other aquatic organisms and aquatic species at risk?

b. What are the historical conditions, current conditions and desired future conditions contributing to water quality and ecosystem health in riparian areas?

SOCIAL SYSTEM

VI. PUBLIC USES

a. What resources (water, timber, firewood, wildlife, sand, cinders etc.) used by humans have been extracted from the ecosystem in the past and at what magnitude?

b. What ability does the watershed have to provide for past and current uses and what types and intensity of recreational use (wilderness access, hunting, trapping, camping, fishing, hiking and sightseeing) are occurring in the watershed?

c. Does the existing transportation system (roads, trails) serve the current and future needs?

CHAPTER 3 - CURRENT CONDITIONS

HYDROLOGY

Big Butte Springs discharges exceptionally high quality water that is consistently cold, clear, and low in mineral content. Natural chemical and physical characteristics place the spring water in the "pristine" classification. No man-made contaminants have ever been detected in this source. Spring flows are collected underground and require minimal treatment (disinfection only) to meet all current water quality standards. It is the intent of the U.S. Forest Service to manage the National Forest land within the watershed to continue these conditions.

Currently, Big Butte Springs is classified as a groundwater source for municipal supplies. Pending amendments to the Safe Drinking Water Act could complicate watershed management strategies if the Springs are reclassified as a surface water source. Because of possible surface water influences, the City of Medford is vitally interested in all land management activities within the Watershed. The possible influence of surface water is also the reason behind the enlargement of the Watershed boundary from slightly more than 22,000 acres to the present size of 56,400 acres. **Figure 4** shows the infiltration zones as determined in the Geohydrologic study.

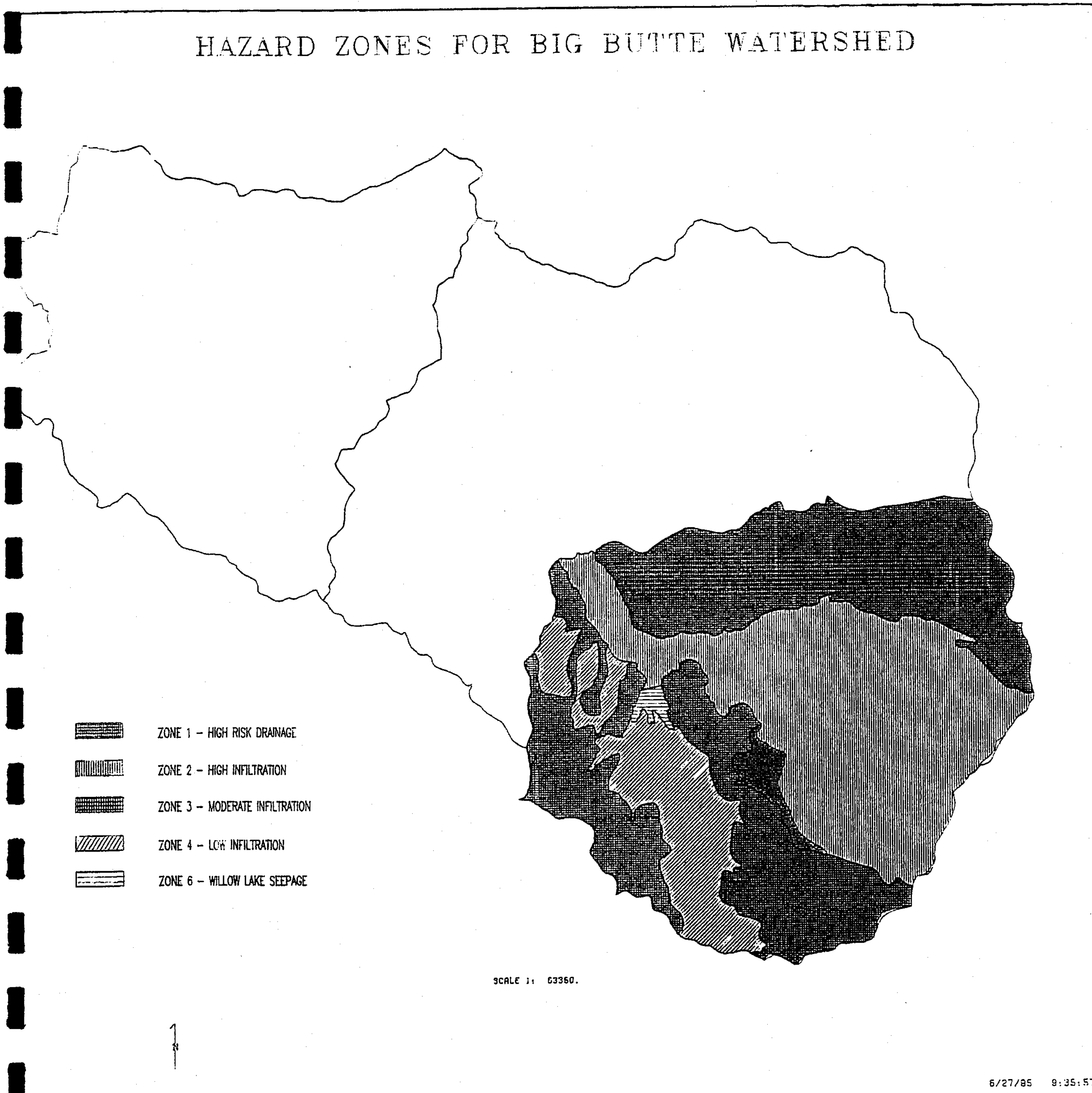
The Medford Watershed Commission has funded a Wellhead Protection Plan which identifies sources of water quality contamination from human activities as well as "acts of God." Human-related sources of concern are: agricultural practices, fertilizers, forest management practices, petroleum products, pesticides, minerals and mining activities, range use, residential developments, recreational use, septic and sewage, surface water impoundments, and roading. Natural hazards are drought, earth-quake, fire, flood, and volcanic eruption. The Wellhead Protection Plan has rated each of these hazards according to their associated risk.

Riparian Reserves:

The Presidents Forest Plan calls for riparian reserves along all streams and wetlands. The Plan specifies a reserve width of two tree heights (312 feet) on each side of all fish bearing streams and one tree height (156 feet) along other streams. Approximately 5,735 acres of riparian reserves are identified within this Watershed. Past timber management activities have entered many of the Riparian Reserves. While most of the streams adjacent to harvest units were protected by riparian buffers of varying widths, few were accorded the widths suggested in the plan. Additionally, few of the other riparian reserve guidelines for protecting aquatic habitat were considered in management activities prior to 1994.

The Geohydrologic Study completed in 1990 raised the question of whether some of the water that seeps from Willow and Fourbit Creeks into the groundwater reservoir might be reappearing at Big Butte Springs. If this happens, then there is a possibility for pollution from the two streams to mix with the groundwater in Big Butte Springs. This concern led to the increase in the extent of land classified as municipal watershed.

Big Butte Watershed
Figure 4



Water Rights:

Subject to existing water rights on May 29, 1925, the City of Medford was granted exclusive rights to use the waters in Big Butte Creek and its tributaries for municipal purposes. When Medford was granted exclusive use of the unappropriated waters in Big Butte Watershed, the State of Oregon also provided for a use of 100 CFS by the Eagle Point Irrigation District. The diversion for this water right is located just below the falls on Big Butte Creek at the town of Butte Falls. Part of the irrigation district's water right is for water from Big Butte Springs. In order to have exclusive use of this high quality water for municipal purposes, the City of Medford constructed a dam on Willow Creek and impounded water in Willow Lake. Water is stored and later released from this 8,200 acre-foot reservoir to supplement flows in Big Butte Creek for use by the irrigation district.

Diversions of water from Big Butte Creek for irrigation purposes account for the fact that the long-term average flow in Big Butte Creek is lower in the lower stream than in the upper portion of the Watershed.

Water Quality Data:

Most of the information on water quality has been collected on Big Butte Springs by the Medford Water Commission. There is not much data for other streams within the Watershed. The Forest Service collected stream temperatures on Fourbit Creek in 1993 and 1994 (see **Figure 5**). Temperatures are generally very good and indicate good shading of Fourbit Creek by streamside vegetation and probably a fair input of cold groundwater from springs into the stream.

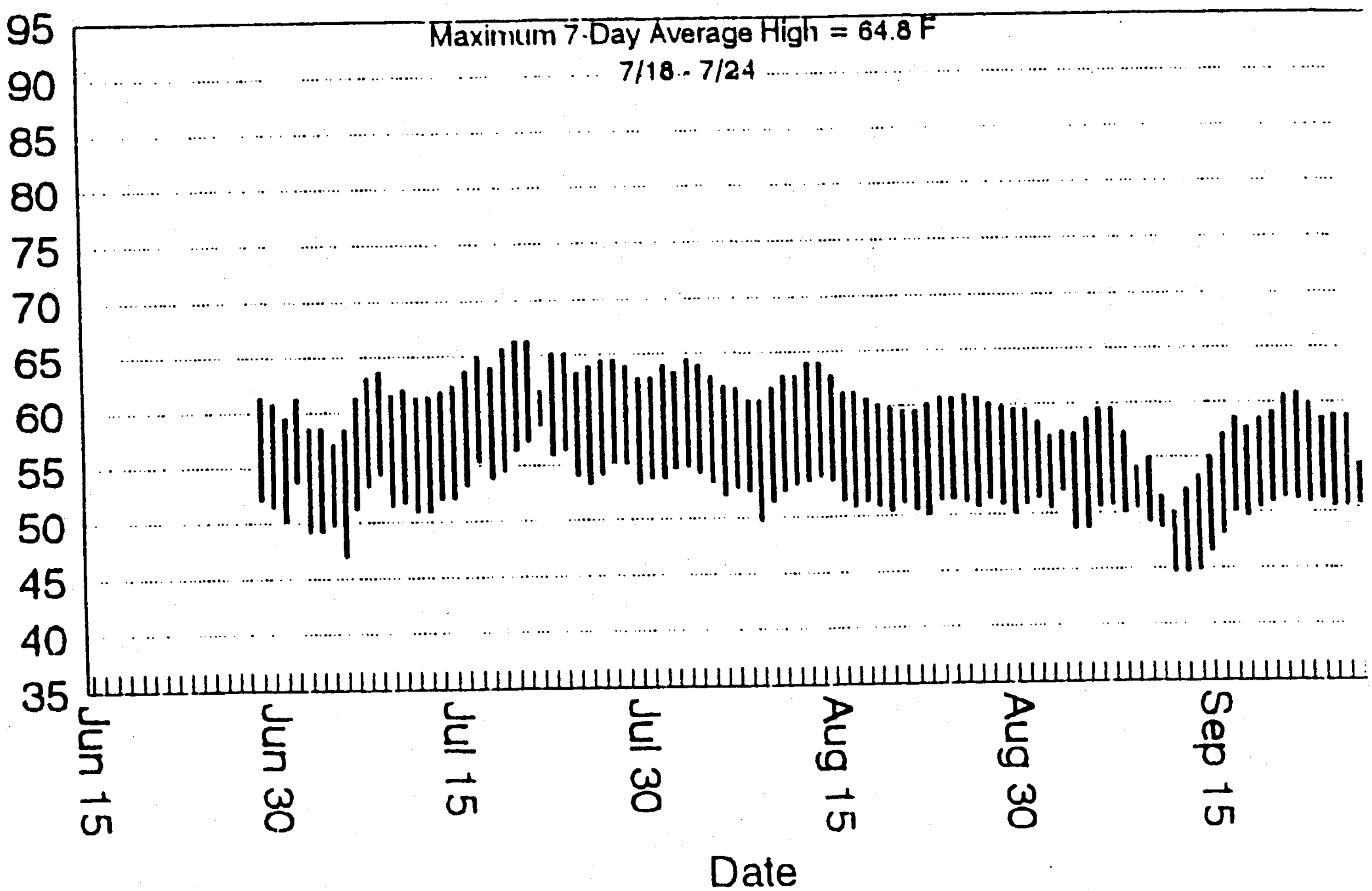
The Medford Water Commission has done some water quality monitoring on surface streams within the watershed. The general increase in parameters downstream is compared to upstream conditions in **figure 6**. This shows increased dissolved minerals as the water moves through older rock types on its way downslope. **Figure 7** also shows the generally low amounts of dissolved minerals in the water, indicating that the water is of very good quality.

Monitoring data from the Medford Water Commission for Big Butte Springs documents the extremely high quality of the water in the Springs. Turbidities average less than one NTU on a daily basis. Water temperatures are usually in the range of 44 to 46 degrees Fahrenheit. Bacterial counts are extremely low. All of the chemical parameters also continually measure in low ranges. This accounts for the fact that Medford has only to add a small amount of chlorine to the water as it enters the pipelines. No other treatment is necessary for this water to meet the requirements of the Clean Water Act for drinking water quality. Monitoring by the water commission over a period of thirty years shows that water quality has been remarkably consistent.

The 56,400 acre Upper Big Butte Watershed represents 36 percent of the entire Big Butte Watershed. Flow from the upper watershed totals 116,600 acre-feet annually at Butte Falls. Total flow at the mouth of Big Butte Creek totals 201,400 acre-feet per year. The 58% of the total flow contributed by the upper Watershed is more important than the volume of water alone; it represents most of the extremely high quality water in the Watershed. Temperatures are generally low. Studies by the Medford Water Commission show surface water quality is generally high (See **Figure 6 & 7**).

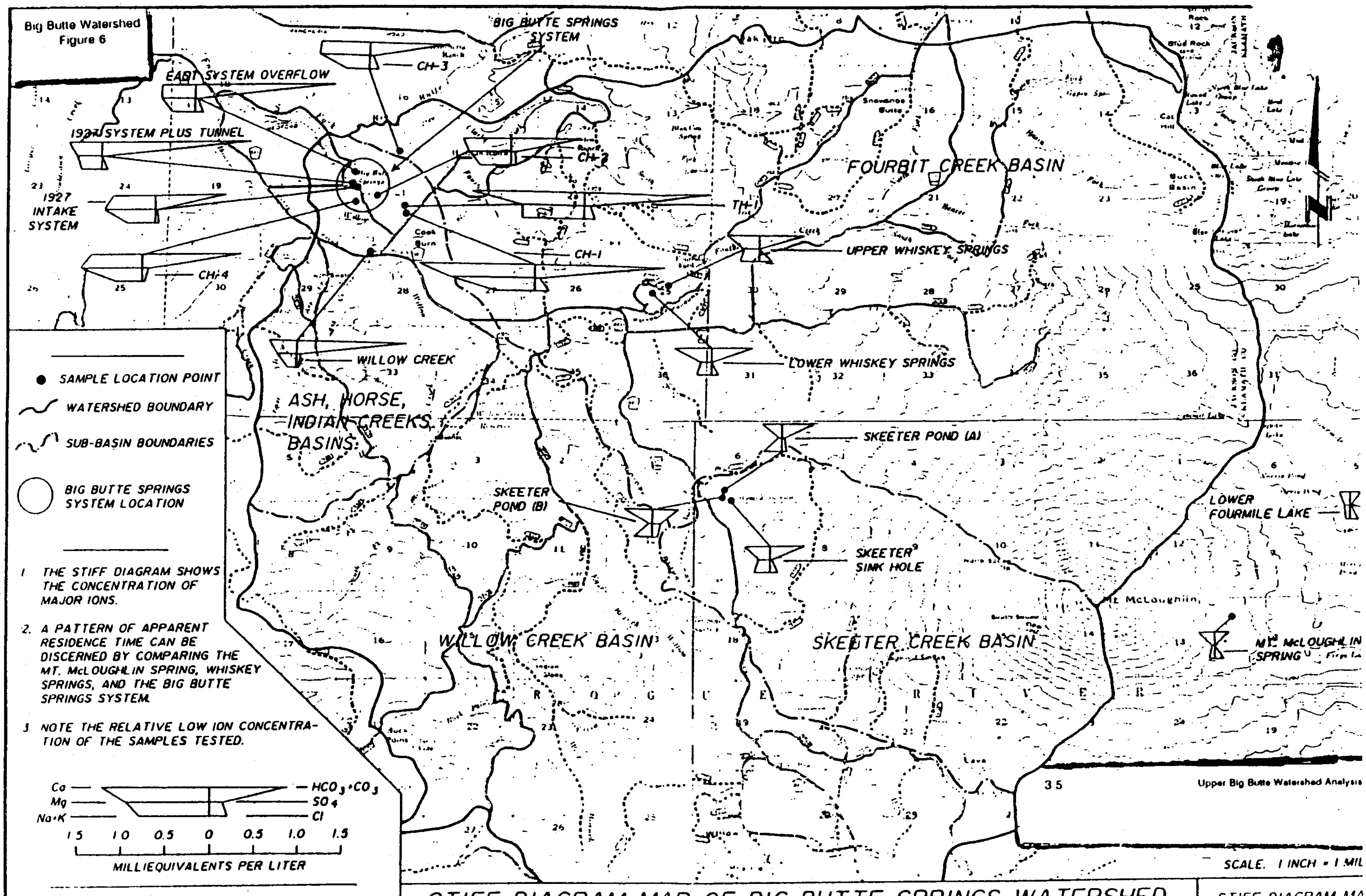
Fourbit Creek

1994 Temperature Study



T35S, R4E, S20 - Butte Falls RD, Rogue River NF

Big Butte Watershed
Figure 6

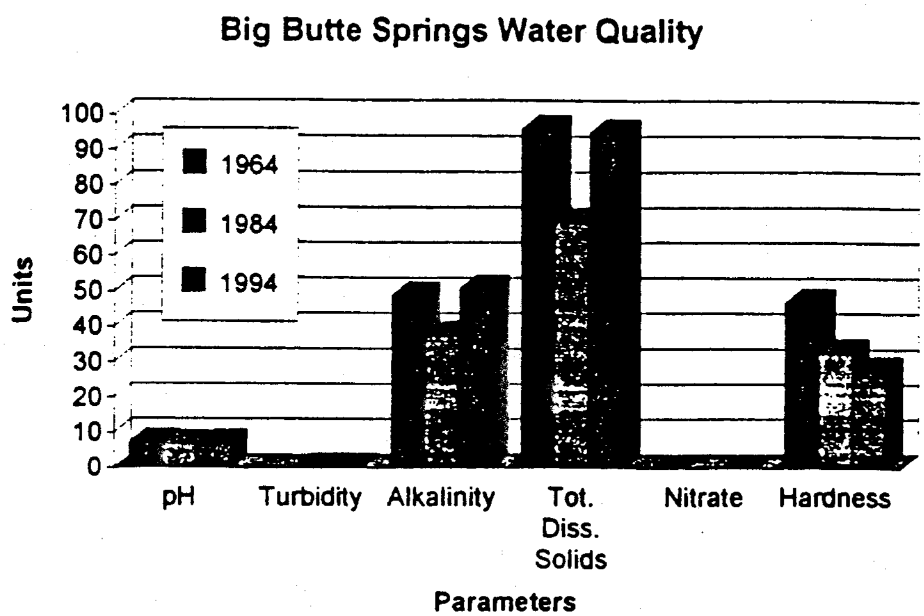


MEDFORD WATER COMMISSION
BIG BUTTE SPRINGS WATERSHED

STIFF DIAGRAM MAP OF BIG BUTTE SPRINGS WATERSHED

STIFF DIAGRAM MA

Big Butte Watershed
Figure 7



There are about 97 miles of streams within the upper Watershed. Slightly more than half of these streams are perennial. A breakdown of the streams by class shows the following:

Stream Class Miles are: I (11.45), II (21.68), III (16.94), and IV (46.97) (See **figure 8**). Stream density in the Watershed is 1.23 mi./square mi. This is lower than on much of the Rogue River National Forest and reflects the geology of the area. Hydrology/runoff is not flashy due to the low stream density and high infiltration rates in the area. Mean annual flow varies about three times (low flow to high flow) in upper Big Butte Creek. In other areas on the National Forest, this variation in streamflow can be as high as 90 to 100 times.

Flows in Big Butte Creek generally follow precipitation patterns. Peak precipitation occurs in the months of November through March. **Figure 9** shows the average monthly precipitation at Butte Falls. Stream flows lag behind the rainfall patterns by about a month. Flows generally peak in December and January. There is a secondary peak in stream flow in March-April when the winter snows begin to melt. Generally the highest flows occur in December and January and are a result of rain on snow events. **Figure 10** shows the mean daily hydrographs for Big Butte Creek at its confluence with the Rogue River near McLeod and the South Fork at Butte Falls. Compared to other Watersheds on the Rogue River National Forest, storm events do not produce as large a peak flow in Big Butte Creek due to the high infiltration rates within the watershed and also the low stream density.

Flows in Big Butte Springs generally remain steady throughout the years. There has been a slight response to the low rainfall amounts in recent years. Flows in the springs during this period have dropped off about 10 cubic feet per second. **Figure 11** shows the flows in Big Butte Springs in recent years as compared to those in Big Butte Creek and with the South Fork. They are very steady compared to the large changes in Big Butte Creek, shown in **Figure 10.**

Big Butte Springs provides a steady supply of high quality water on a year-round basis. Average daily flows are about 26 million gallons per day (about 40 CFS). Medford began using the water from Big Butte Springs as its sole source of municipal water in 1927. Two, 31 inch pipelines carry water from the Springs to Medford on a continual basis. For most of the year, water from Big Butte Springs provides for all of the water needs of the customers of the Medford Water Commission. During the summer, when demand exceeds the supply from the Springs, the City supplements the water from the Springs with water from the Rogue River.

The U.S. Forest Service manages the majority of the lands within the Upper Big Butte Creek Watershed as a part of the Rogue River National Forest (see **Figure 12**). Ownership of the 56,400 acres within the Watershed is as follows:

Medford Water Commission	5.6 %
Rogue River National Forest	74.4 %
Bureau of Land Management	0.9 %
Medite Corporation (Medco)	18.0 %
Boise Cascade Corporation	0.1 %
Other Private	1.0 %

Hydrologically, the Upper Big Butte Creek Watershed can be stratified into three subwatersheds; Willow Creek, Fourbit Creek, and Skeeter Creek. There are few wetlands in the Watershed except those associated with the creeks. Most of the springs in the Watershed have been developed for cattle use.

Big Butte Watershed
Figure 8

BUFFERED RIPARIAN / STREAM CLASS FOR BIG BUTTE WATERSH

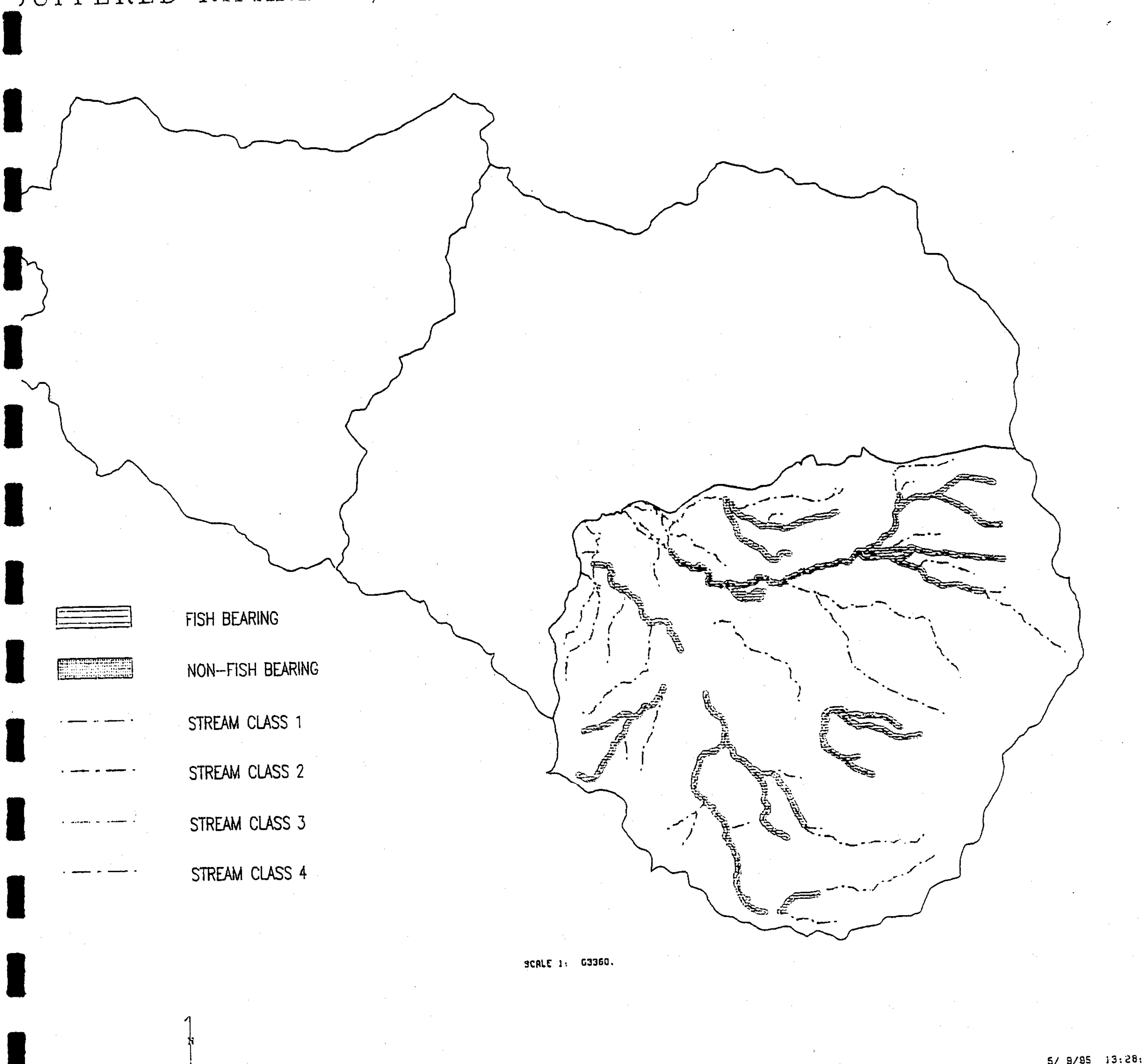
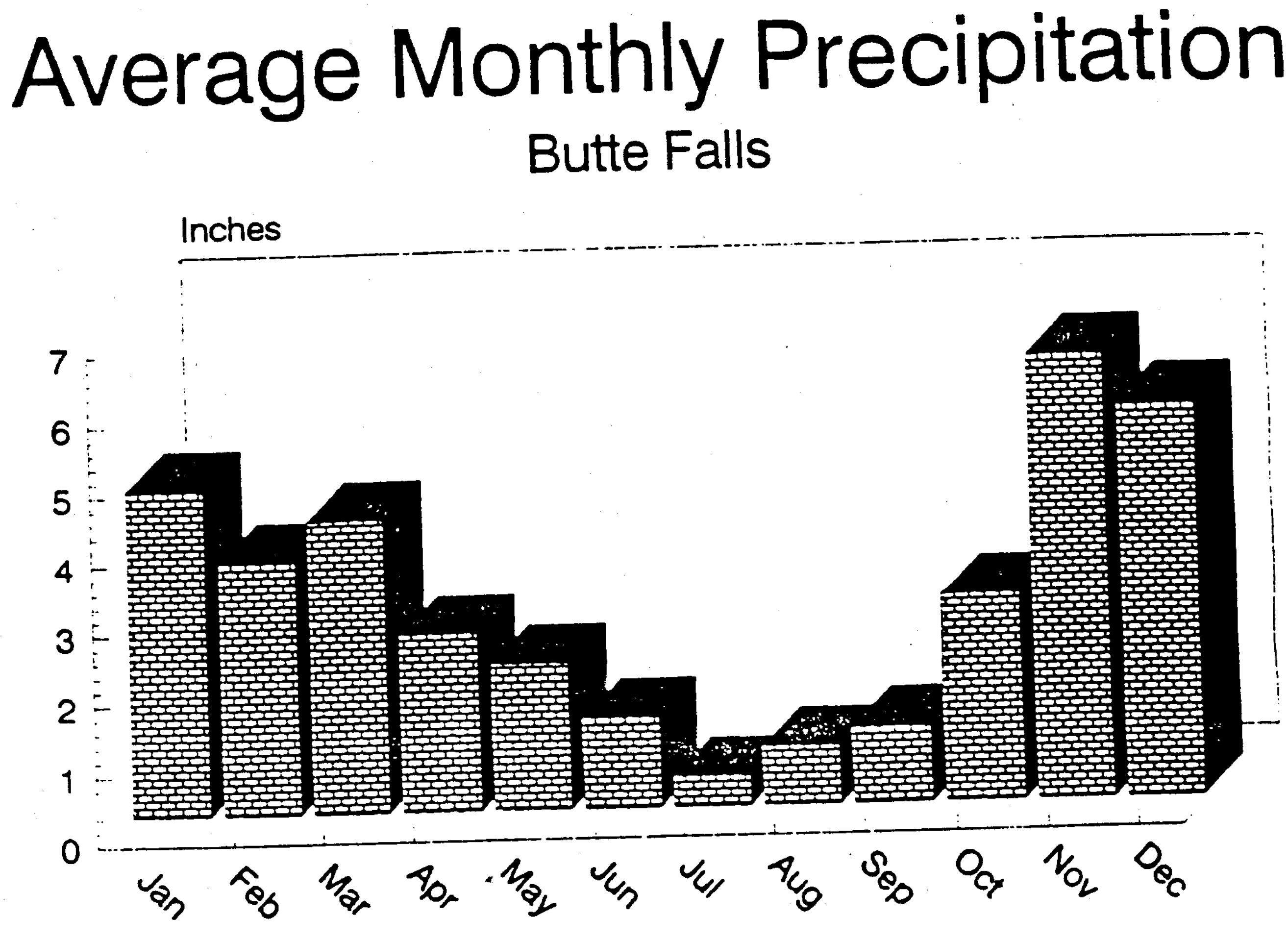
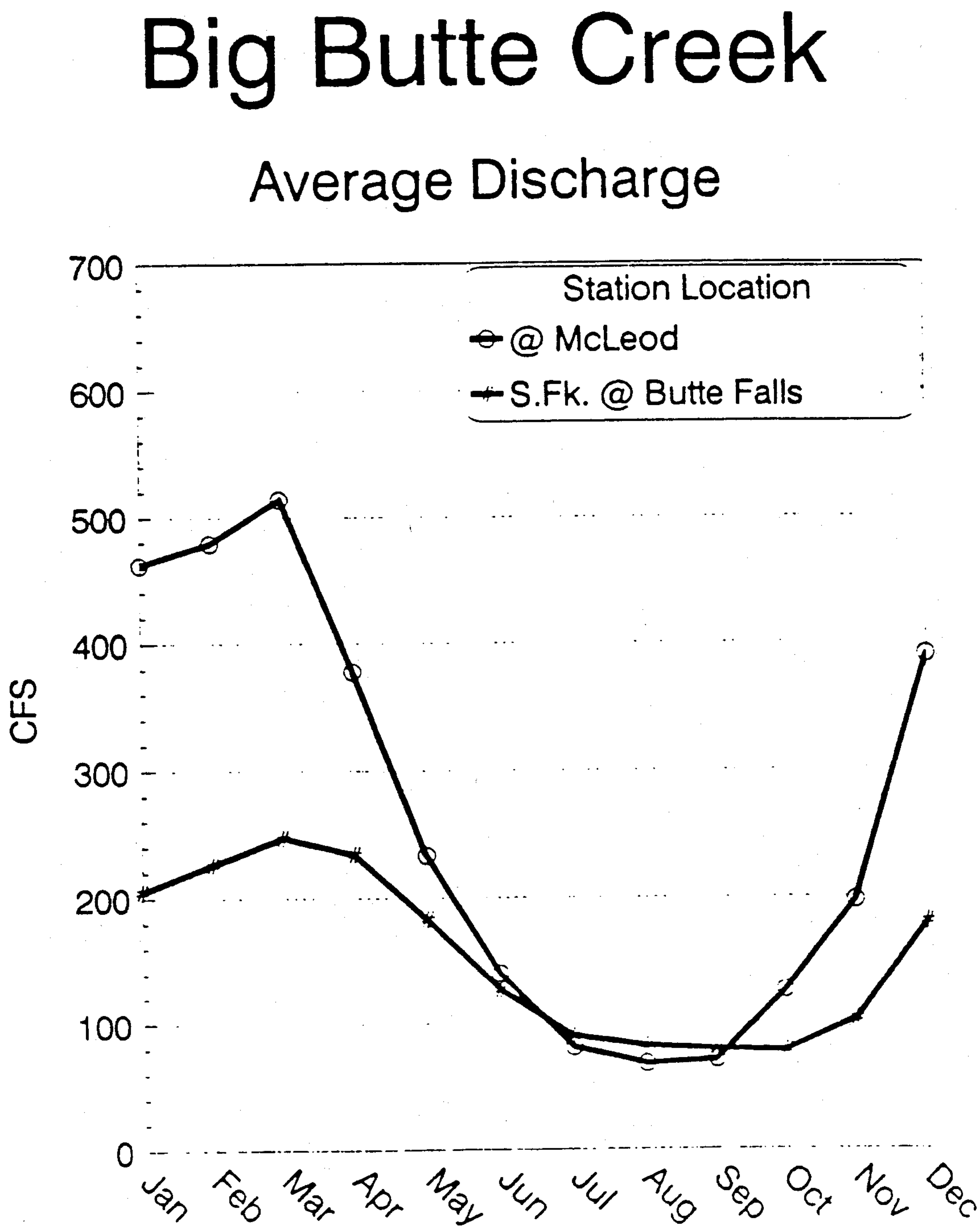


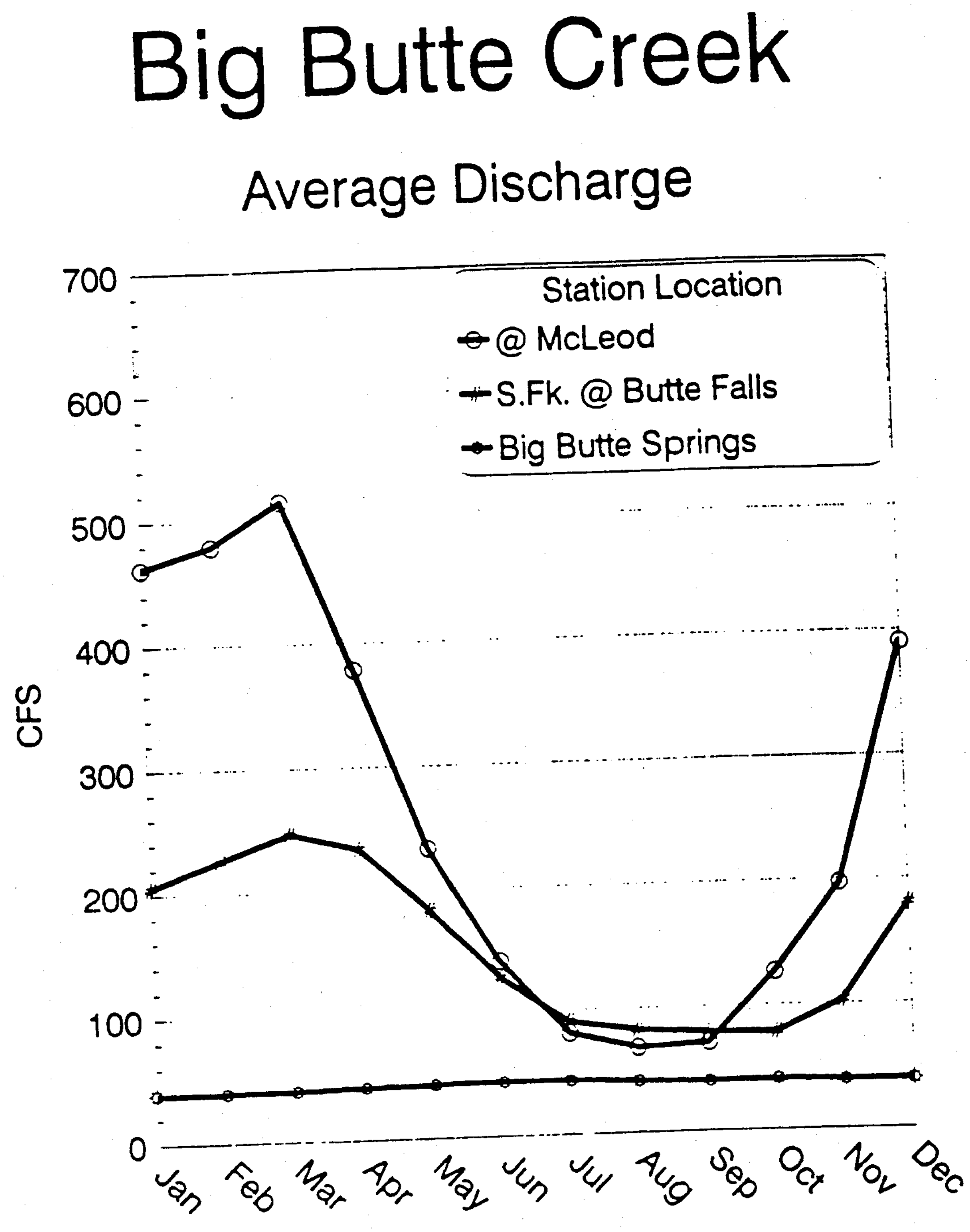
Figure 9


Average Monthly Precipitation
Butte Falls
Inches
7
6
5
4
3
2
1
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

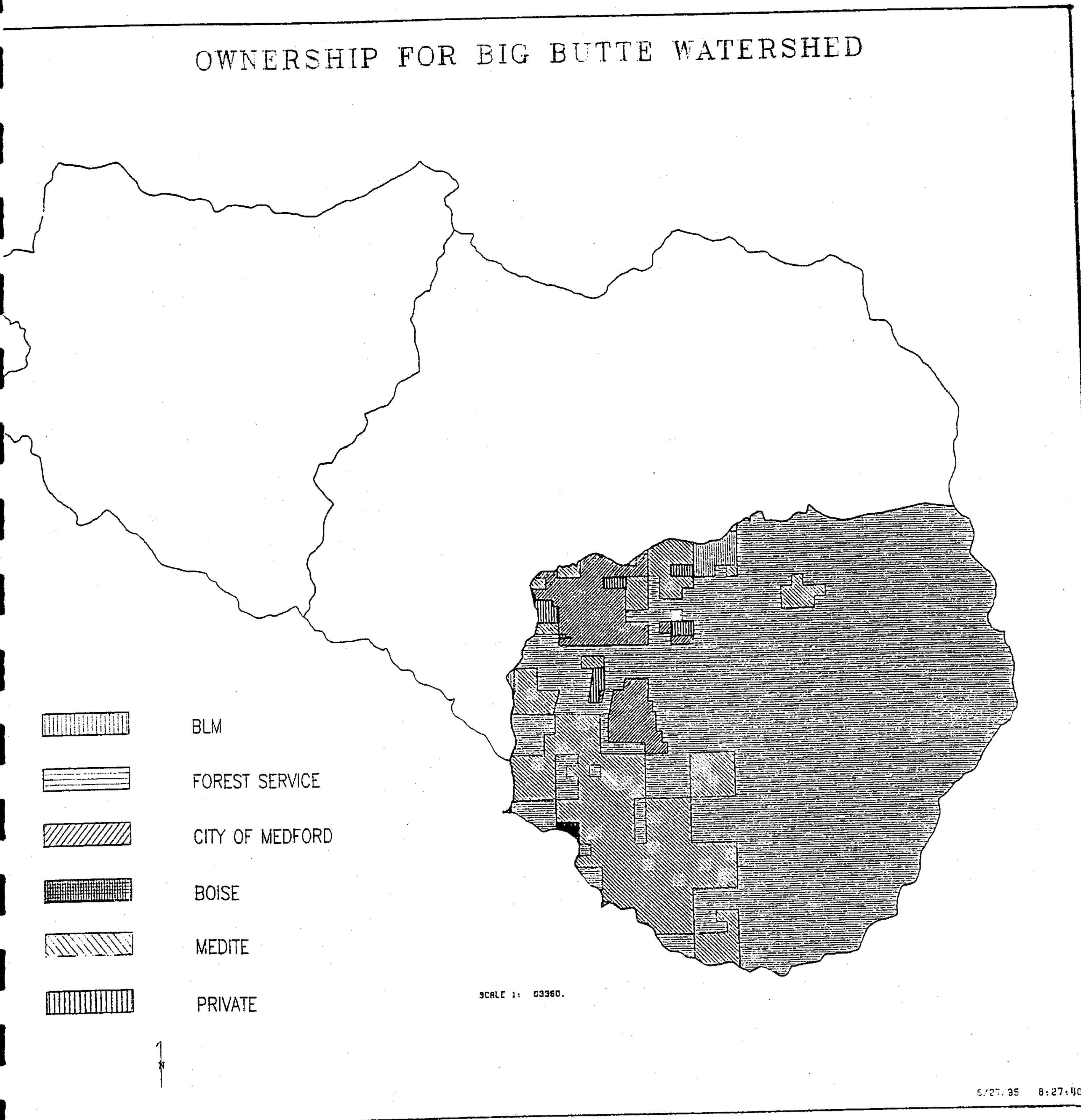
Big Butte Watershed
Figure 10



Big Butte Watershed
Figure 11



Big Butte Watershed
Figure 12



The Big Butte Springs Geohydrologic Report contains a thorough description of the geology of the Watershed. Brief descriptions of these three areas follow.

Willow Creek: Western Cascades geology dominates in this subwatershed. Soils are higher in clay content and produce more turbid runoff during storm events than Fourbit and Big Butte Creeks. It is not unusual to see Willow Creek flowing with a slight milky color during much of the year. This color is due to the colloidal material eroded from the Watershed. Water yield is about 0.9 CSM (cubic feet per second per square mile). This is 50% greater than the yield in Fourbit Creek. The higher water yields are an indication of a need for more frequent drainage culverts on road systems and for additional erosion control structures where ground disturbing activities are occurring.

Fourbit Creek: About half of the Fourbit Creek subwatershed is in the High Cascades Geologic Province and half in the Western Cascades. Runoff is much clearer than in Willow Creek due to the lower amounts of clay soils in the basin. Water quality is high and the water does not have the milky color associated with Willow Creek. Water yield is 0.6 CSM.

Skeeter Creek: This subwatershed is mainly in the High Cascades. There is no surface outlet for water within this Watershed. The entire amount of water flowing in Skeeter Creek seeps into the ground below Skeeter Swamp. It is thought that this water emerges again at Big Butte Springs. Water yield from this basin is about 0.3-0.5 CSM.

Diversions of water from Big Butte Creek for irrigation purposes account for the fact that the long-term average flow in Big Butte Creek is lower in the lower stream than in the upper portion of the Watershed. In the months of July, August, and September, flows at McLeod are lower than at the South Fork near Butte Falls (see **Figure 13**).

Precipitation amounts in the watershed vary according to elevation, the western portions receive 35 to 40 inches annually, while the eastern portion receives fifty to seventy inches (see **figure 14**).

Clean Water Act Information:

There are no water quality limited streams within the Big Butte Creek Watershed. The only problems identified in the 1988 Statewide assessment were in Willow Lake. The water quality problems were associated with drainage from the sewage system for the campground and recreation area into the Lake. This has led to algae blooms that have caused health problems in some swimmers. There was also a moderate problem with pesticides and excessive plant growth that impacted beneficial uses such as cold water fisheries and aesthetics.

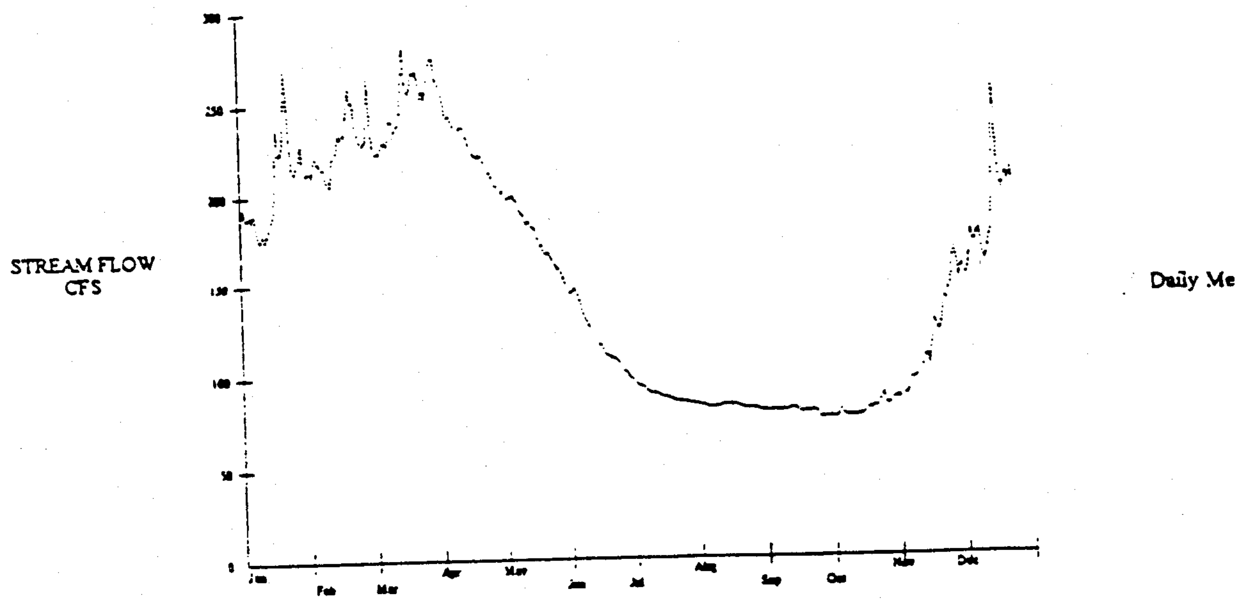
FOREST VEGETATION

The health of forests in Upper Big Butte Watershed is tied to the management of disturbance processes. Disturbance is the disruption of succession and is essential to the maintenance of ecosystem stability, biological diversity, resiliency and ecosystem health.

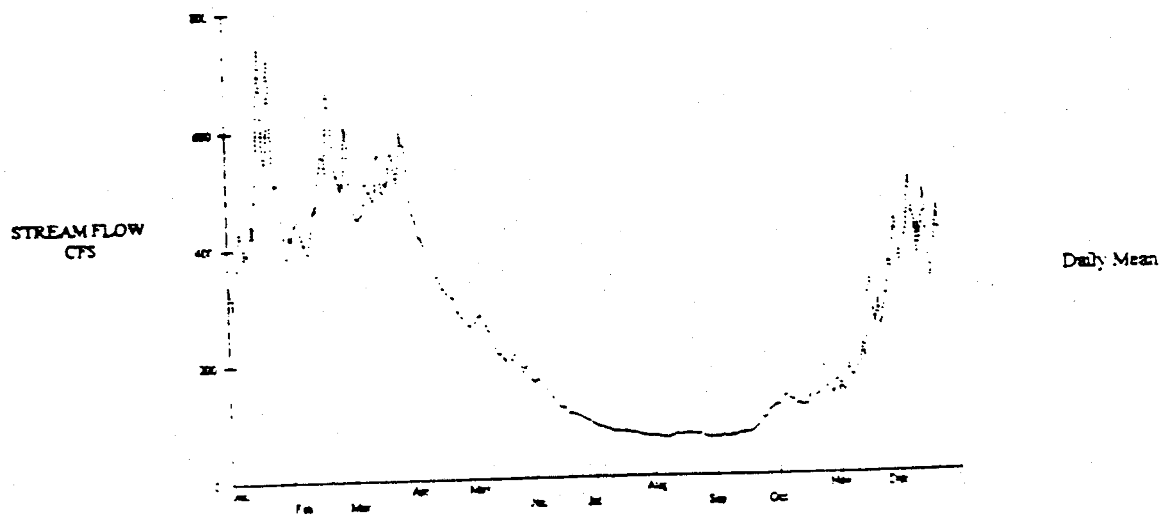
Shasta red fir, Pacific silver fir and western hemlock are adapted for establishment and growth in small openings caused by minor disturbances, such as the death or harvesting of a single large tree. Douglas-fir, ponderosa pine and sugar pine are well adapted to large openings created by wildfire, extensive windthrow, flooding, timber harvesting, or agricultural cultivation.

Figure 13

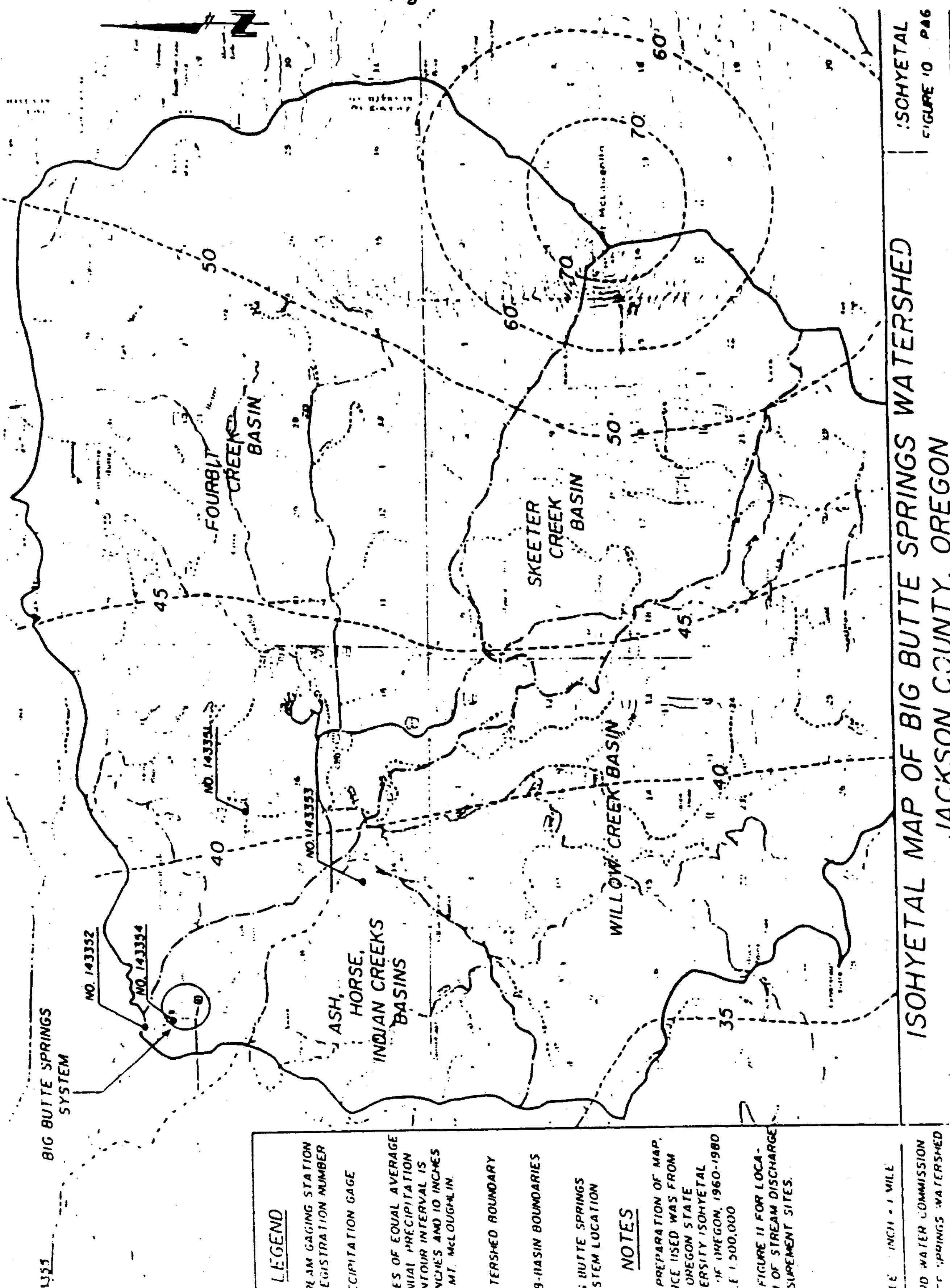
SOUTH FORK BIG BUTTE CR NR BUTTE FALLS,OREG.



BIG BUTTE CREEK NEAR MCLEOD,OREG.



Big Butte Watershed
Figure 14



These species can become established and grow rapidly in conditions of bare soil, full sunlight and relatively wide temperature fluctuations associated with large forest openings. Incense cedar and white fir are well adapted to openings of intermediate sizes or to disturbances of moderate severity. Many species are able to complete their life cycles in openings of various sizes.

Selective harvesting over the years has increased root disease inoculum levels by creating cut-stumps and open wounds on residual trees, both of which act as infection courts. It also increases the food base available to some root disease-causing fungi. Increased wounding levels in residual trees also favors high rates of colonization by stem decay fungi.

Insect and disease activity has increased since the turn of the century as a result of fire exclusion, introduction of exotic organisms and management activities. In historical times periodic fires kept stocking levels low to moderate. Dwarf mistletoe infection levels were relatively low because ground fires destroyed both infected understories and the heavily infected overstory trees with large brooms close to the ground. Shade tolerant trees, generally more susceptible to root diseases and stem decays than seral species, were also limited by frequent fires.

Tree growth on some sites throughout the watershed has been reduced by compaction of soils by tractors or rubber-tired machines used for moving logs, piling of logging debris, removing unwanted trees or shrubs, and from multiple entries.

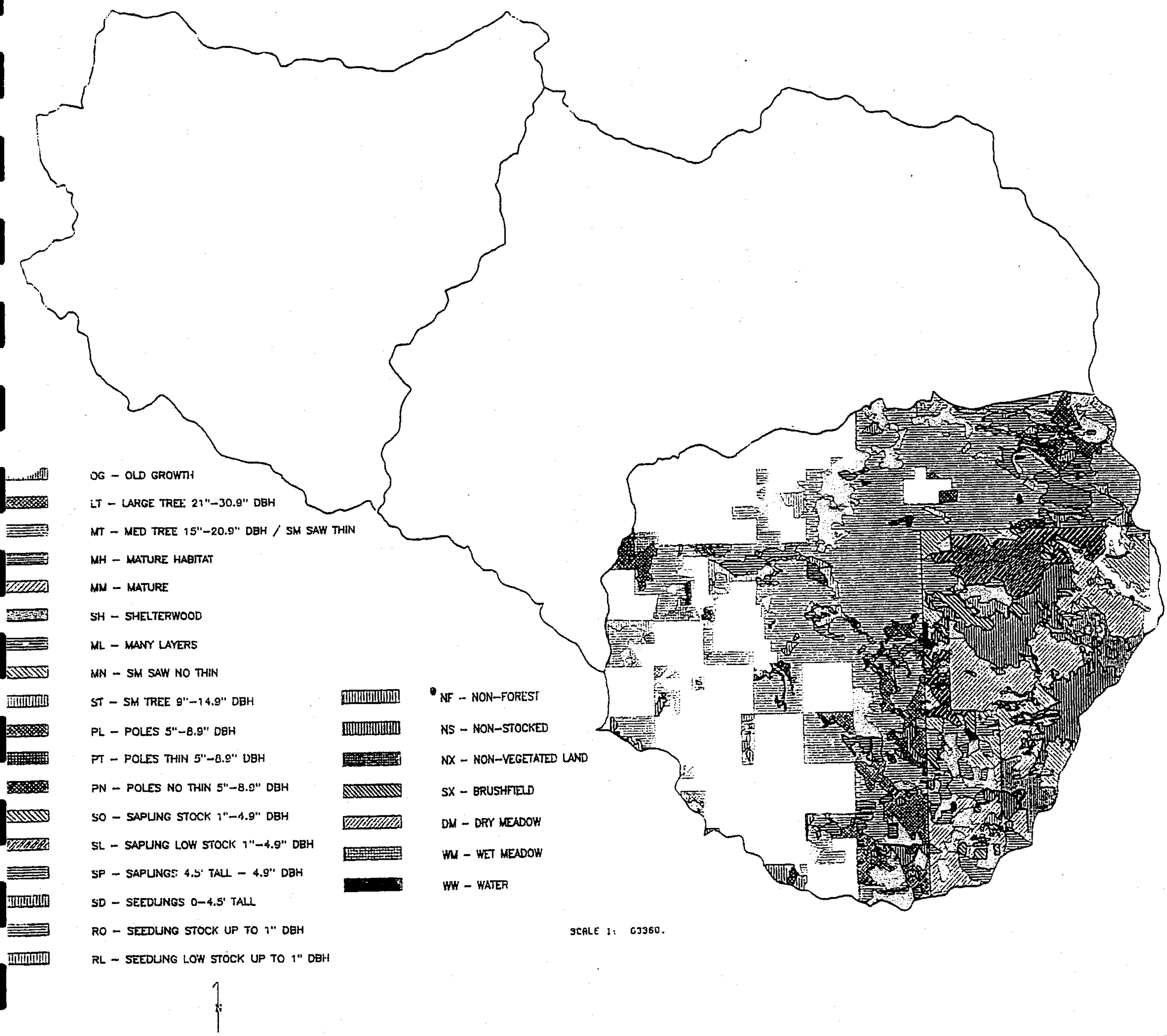
Stand growth frequently is limited by available nitrogen, most of which is stored near the soil surface. Therefore, site disturbances to promote regeneration must be done with great care so topsoil is not lost or displaced and so impacts to mycorrhizae are minimized.

BIG BUTTE WATERSHED STAND CLASSIFICATION ACRES (see **Figure 15**)

Classification	*Acres*	*% of Total Area*
NON-TIMBER AREA:		
Unclassified/Other	14,409	25.7
Dry Meadows	50	0.1
Wet Meadows	415	0.7
Brushfields	10	0.1
Non-Forest	2,831	5.1
Water	6	0.1
SUBTOTAL of Non-Timber Area	17,721	31.8
TIMBER AREA:		
Non-Stocked Timber Ground	50	0.1
Old Growth	2,885	5.2
Shelterwood	3,876	6.8
Mature Timber	4,114	7.4
Medium Saw Timber	16,533	29.5
Small Saw Timber	1,758	3.2
Poles	1,312	2.4
Saplings	811	1.5
Seedlings	6,504	11.6
Non-Vegetated Timber Ground	253	0.5
SUBTOTAL of Timber Area	38,096	68.2
Other Private lands:	**617**	**1.1**
TOTAL	56,434	100.0

Big Butte Watershed
Figure 15

STAND LAYER FOR BIG BUTTE WATERSHED



AREA SUMMARY FOR MAP BBWS_STD_FS ACTIVE MAP NO. 4

SUBJECT	AREA	FREQUENCY	PERCENT
BIG_BUTTE_SPRING	6889.09	10	12.34
DM BIG_BUTTE_SPRING	50.02	2	.09
LT BIG_BUTTE_SPRING	1748.95	16	3.13
MH BIG_BUTTE_SPRING	20.64	2	.04
ML BIG_BUTTE_SPRING	62.34	1	.11
MM BIG_BUTTE_SPRING	4114.13	18	7.37
MN BIG_BUTTE_SPRING	1758.41	16	3.15
MT BIG_BUTTE_SPRING	16532.73	61	29.62
NF BIG_BUTTE_SPRING	2830.82	40	5.07
NS BIG_BUTTE_SPRING	49.97	5	.09
NX BIG_BUTTE_SPRING	252.72	30	.45
OG BIG_BUTTE_SPRING	1052.95	5	1.89
OT BIG_BUTTE_SPRING	7520.03	2	13.47
PL BIG_BUTTE_SPRING	1231.27	18	2.21
PN BIG_BUTTE_SPRING	23.46	1	.04
PT BIG_BUTTE_SPRING	57.04	5	.10
RL BIG_BUTTE_SPRING	203.63	4	.36
RO BIG_BUTTE_SPRING	606.93	18	1.09
SD BIG_BUTTE_SPRING	957.06	41	1.71
SH BIG_BUTTE_SPRING	3875.74	60	6.94
SL BIG_BUTTE_SPRING	2017.69	6	3.61
SO BIG_BUTTE_SPRING	562.34	19	1.01
SP BIG_BUTTE_SPRING	2112.49	32	3.78
ST BIG_BUTTE_SPRING	854.23	20	1.53
SX BIG_BUTTE_SPRING	10.01	1	.02
WM BIG_BUTTE_SPRING	414.98	21	.74
WW BIG_BUTTE_SPRING	6.19	4	.01
TOTAL (IN ACRES)	55815.87	458	100.00

NON-NATIVE PLANTS AND NOXIOUS WEEDS

Two types of plants are considered to be undesirable or at least cannot be considered beneficial under certain situations: non-native invasive species, and noxious weeds (those toxic to livestock).

A non-local source of seed may be as bad as introducing an exotic species. Non-local native stock may be less adapted to a specific environment because they do not bring with them the genes needed to survive in the new environment. This may cause unsuccessful establishment or an introduction of genes that could negatively affect the fitness of the local gene pool.

A few of the non-native plant species that are especially harmful to our local native gene pool include:

- Kentucky bluegrass (*Poa pratensis*)
- colonial bentgrass (*Agrostis tenuis*)
- cheat grass (*Bromus tectorum*)
- redtop (*Agrostis alba*)

These are only a few of the "increaser species". Increasers are an indicator of overgrazing. Forest policy requires the use of native seed for rehabilitation and revegetation projects. As native grass seed becomes more available, and is used at an increasing rate in the Big Butte watershed, monitoring should become an important part of the process to ensure a healthy ecosystem.

PLANT SPECIES OF CONCERN

Many of the rare plant populations that exist currently in the Big Butte watershed are those that are found in unique areas such as rock outcrops or scablands, that are generally not in conflict with forest management or recreation activities. Rare plants are also found in wetlands, seeps and moist meadows. The most likely impact to these habitats are caused by cattle or invasive opportunistic non-native species. Almost every habitat found within the watershed has potential for rare plant populations although the likelihood of finding them varies according to species and habitat.

Without human intervention, many of these endemic populations would naturally be rare due to evolutionary development of the species. Past habitat modification throughout Big Butte Watershed may have contributed to the decline of certain species through changes in soil, moisture, or light. Removal of the canopy will result in mortality or loss of viability for a few species. For others, the response to habitat modification is unclear.

FUELS

There have been 42 lightning fires and 28 person-caused fires documented in the watershed in the last 32 years (see **figures 16, 17 and 18**). Understory brush with mixed conifer overstory dominates the Cat Hill Burn area. Young mixed conifer stands are prevalent over the remainder of the Watershed. Sivicultural treatments and hazard reduction measures have contributed to early seral stand conditions with lighter fuel loading than found at higher elevations. This vegetation condition is susceptible to stand replacement fire due to understory brush acting as ladder fuel to the relatively low crowns of these young conifers. Fire exclusion within the Sky Lakes Wilderness has contributed to fuel buildup.

INSECTS AND DISEASE

Insects and pathogens are active in the Upper Big Butte Watershed. Insects and diseases are having a profound influence on vegetative structure, stocking, and species composition. The magnitude of insect and disease disturbance is greatly influenced by stand species composition, age class, and history of other disturbances.

Insect and disease activity has increased since the turn of the century as a result of fire exclusion, introduction of exotic organisms, and management activities. In historical times, periodic fires kept stocking levels low to moderate, kept dwarf mistletoe infection levels relatively low, and limited the development of shade tolerant trees (which are generally more susceptible to root diseases and stem decay).

Stocking levels are excessive in the understory over large areas within the watershed. This is a direct result of effective fire suppression and past selective harvesting. Increased stocking, coupled with droughty conditions, has triggered bark beetle caused mortality, particularly in larger overstory pines. Douglas-fir dwarf mistletoe is abundant. Larger overstory Douglas-fir are severely infected and understory Douglas-fir growing beneath infected overstories have become infected or are at high risk of infection. In many areas shade tolerant species are abundant. Root disease centers are maintained by this steady ingrowth of susceptible species and are most likely larger in area than would have occurred during frequent-fire regimes. Selective harvesting has increased root disease inoculum levels by creating cut-stumps and open wounds on residual trees, both of which act as infection courts.

Bark beetles are currently active throughout the watershed in stands with a pine component. Many stands are at high risk due to dense stocking levels which resulted from fire suppression. Mortality appears to be accelerating. Bark beetles will continue to kill the dominant and codominant Ponderosa, western white and sugar pines within these stands unless stocking levels are controlled.

White pine blister rust attacks sugar pine and western white pine in the present analysis area.

Dwarf mistletoes, *Arceuthobium* spp., are parasitic plants that infect conifer species. Infection results in growth loss, topkill, distortion, and mortality,as well as predisposition to further infection and attack by other agents such as *Armillaria ostoyae* and various bark beetles. True fir dwarf mistletoe, and its associated canker fungus *Cytospora abietis*, are contributing to the decline of white fir in some locations. Dwarf mistletoe in hemlocks is particularly problematic as it greatly decreases the merchantability of the trees and kills many branches, increasing the fuels hazard of the area.

Phellinus pini, a fungi causing red ring rot, is commonly found in mature and overmature Douglas-fir, Shasta red fir, white fir, ponderosa pine, sugar pine, and western white pine in the Watershed.

GRAZING

Cattle grazing is another factor influencing the ecosystem. Cattle and sheep have been grazed in large numbers since the 1870's. The vegetative characteristics have changed considerably due to timber harvest, fire control, ranching, and roading. The overall impacts of these changes are not known due to a lack of information on the current status of most species found on the watershed. Current numbers of livestock being grazed appear to be at or near projected carrying capacities on the Fish Lake allotment. No updated analysis has been done on the Rancheria allotment, but it is estimated that numbers are below carrying capacity.

An inter-related effect of cattle and sheep grazing is the introduction of European and Asian grass and forb species to enhance forage production. Native meadow and forest vegetation has often been dominated by these exotic invaders, replacing native ecosystems with foreign components.

THREATENED, ENDANGERED AND SENSITIVE SPECIES

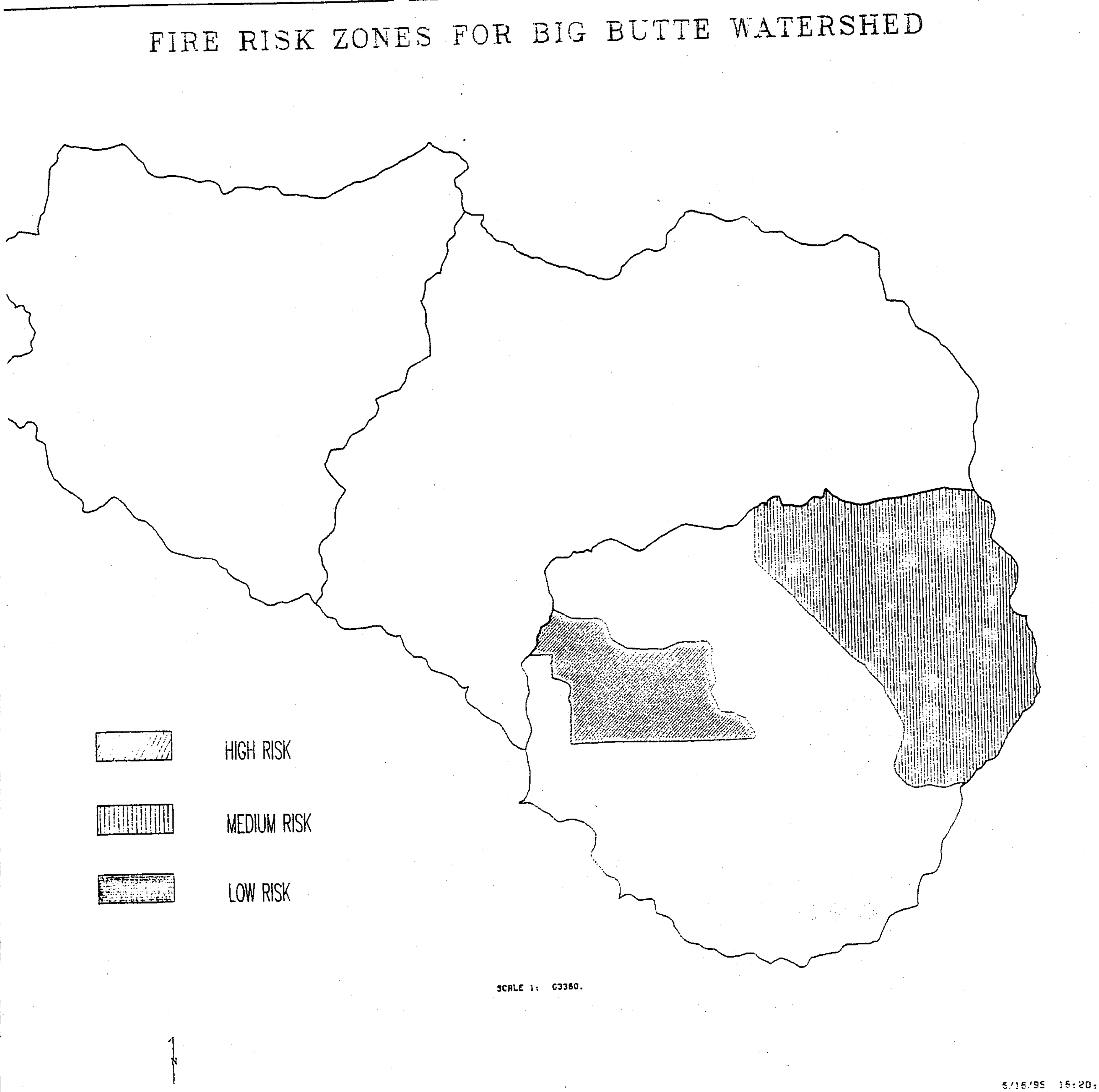
No endangered species are known to currently reside in the Upper Big Butte Watershed area. Peregrine falcons may utilize the area for foraging, but no documented sightings exist.

Threatened species occurring in the watershed include the bald eagle and northern spotted owl. The bald eagle site is located at Willow Lake. One juvenile bald eagle was successfully produced in 1994. The habitat in the area appears to be good.

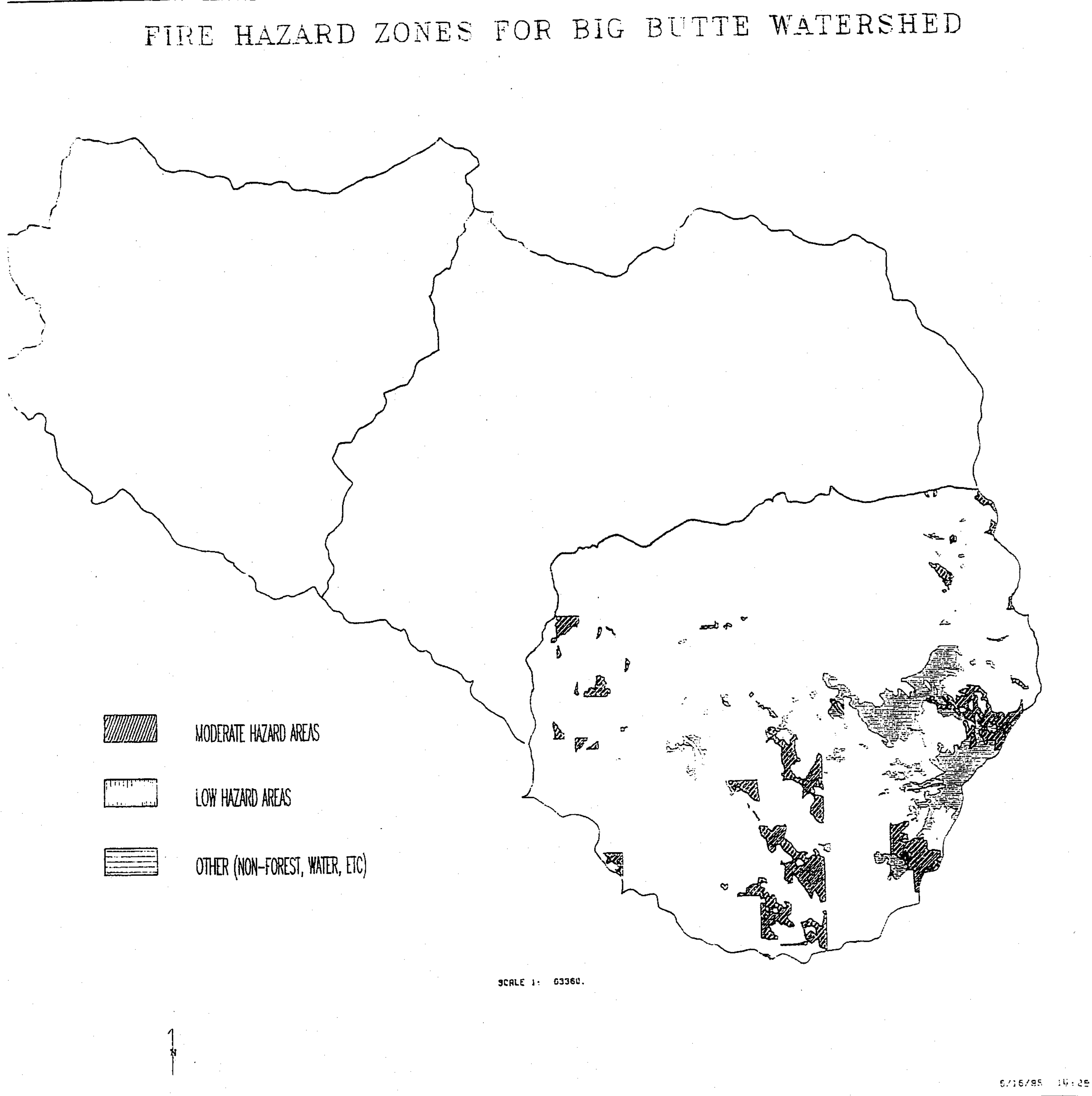
Intensive spotted owl surveys have been conducted since 1989. Seven pairs have been located. Home ranges of all seven pair exceed "Take" thresholds set by the U.S. Fish and Wildlife Service. This indicates that spotted owls within the Watershed are at risk and may be extirpated as a nesting species from the Watershed.

The Big Butte Watershed occupies a large portion of the lands between two late successional reserves (LSR). LSR 227 is a critical link between the Western Cascades and Klamath Mountain provinces. LSR 226 is the primary source for dispersal to LSR 227 from the Cascades. Almost no dispersal has been documented between the LSR's indicating that dispersal habitat may be a limiting factor for the owl population in the area. Of the quarter townships occupied by the watershed, three are below recommended levels of dispersal habitat. See **figure 19** for map of crown closure.

Big Butte Watershed
Figure 16

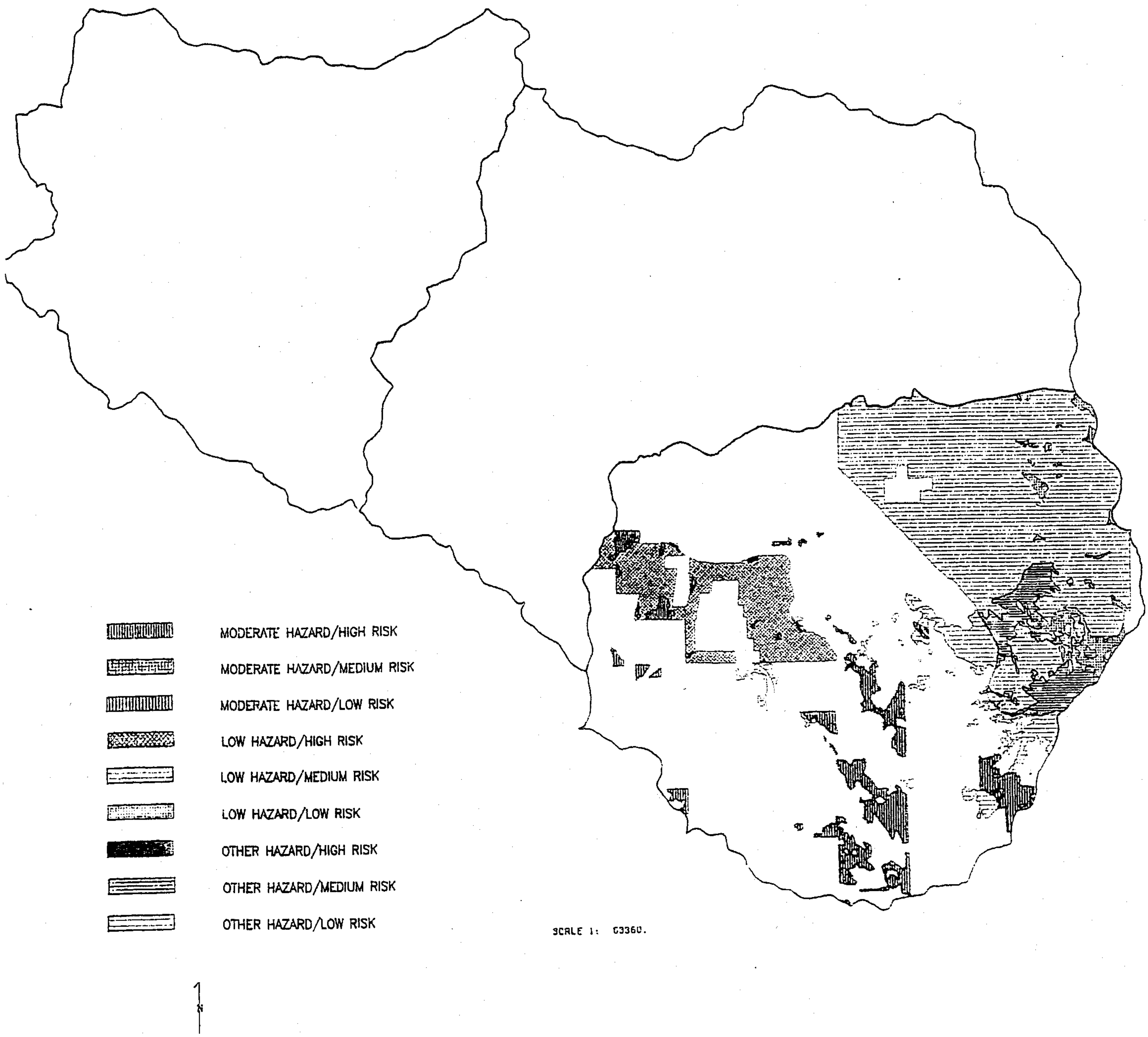


Big Butte Watershed
Figure 17

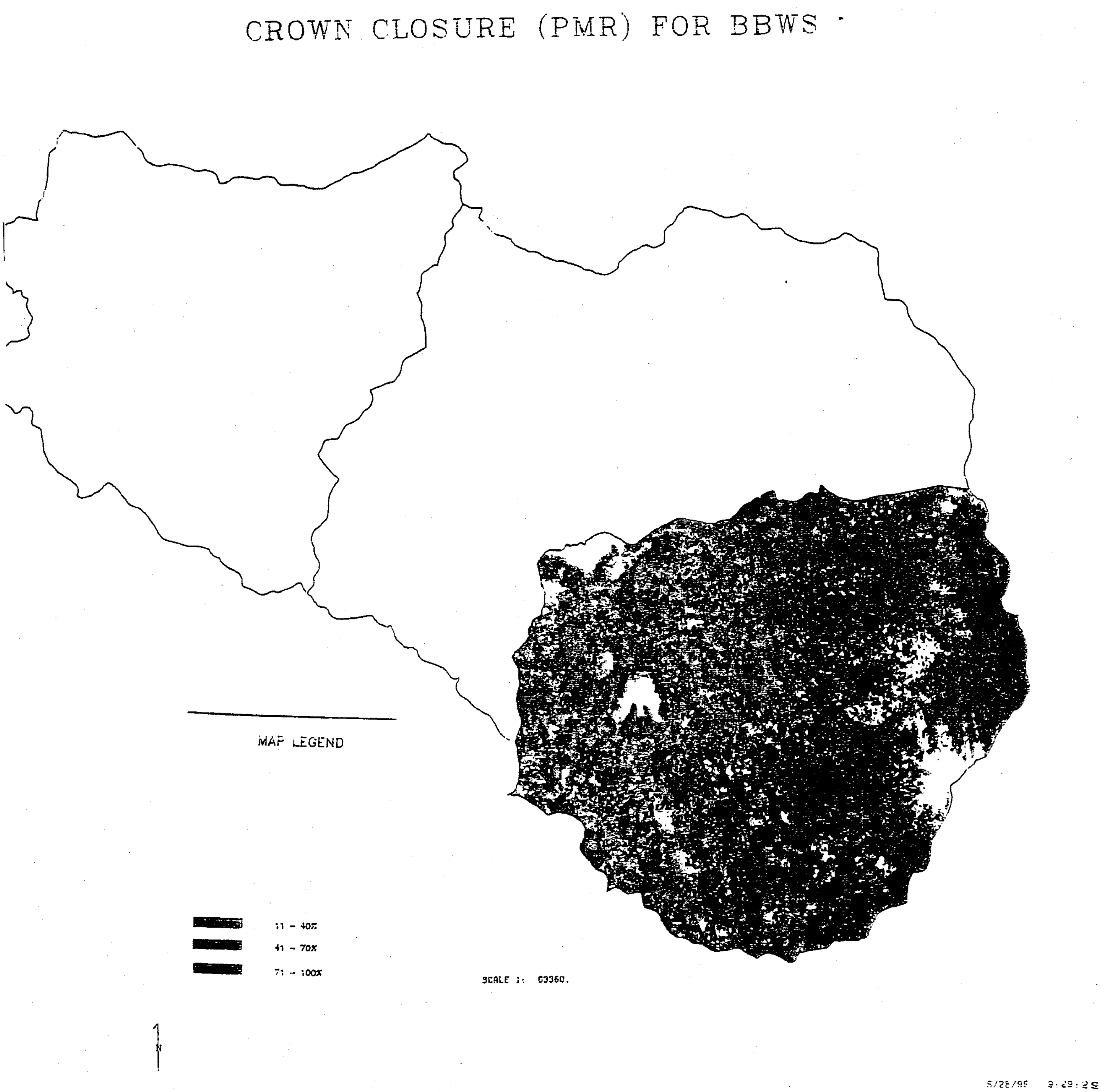


Big Butte Watershed
Figure 18

FIRE HAZARD/RISK ZONES FOR BIG BUTTE WATERSHED



Big Butte Watershed
Figure 19



SUBJECT	AREA	FREQUENCY	PERCENT
HIGH	5403.54	1	9.57
LOW	34818.19	1	61.70
MED	16212.36	1	28.73
TOTAL (IN ACRES)	56434.09	3	100.00

AREA SUMMARY FOR MAP BBWS_FHZA ACTIVE MAP NO. 14

SUBJECT	AREA	FREQUENCY	PERCENT
LOW	35218.58	27	84.48
MOD	3378.92	48	8.11
OT	3089.34	73	7.41
TOTAL (IN ACRES)	41686.84	148	100.00

AREA SUMMARY FOR MAP BBWS_FHRZ ACTIVE MAP NO. 17

SUBJECT	AREA	FREQUENCY	PERCENT
LOW HIGH	3197.77	3	7.67
LOW LOW	18769.71	32	45.03
LOW MED	13251.08	16	31.79
MOD HIGH	256.95	10	.62
MOD LOW	2330.38	28	5.59
MOD MED	791.59	13	1.90
OT HIGH	20.34	6	.05
OT LOW	1491.73	54	3.58
OT MED	1577.27	26	3.78
TOTAL (IN ACRES)	41686.83	188	100.00

Gray wolves and grizzly bears, both on the Federal endangered species list, were once common in the Watershed and are now considered extirpated from the state.

Several sensitive species are known to occur within the watershed: They are: California wolverine, northwestern pond turtle, greater sandhill crane and pacific western big-eared bats. Red legged frogs, white footed voles, Siskiyou Mountain salamanders and ferruginous hawks are potentially found on the Rogue River National Forest, but there is no indication that they exist in this Watershed.

The Watershed has a healthy blacktail deer population, according to the Oregon Department of Fish and Wildlife. The population on the watershed is migratory, with the majority of the area providing summer range. Deer hunting is one of the primary recreational activities that occurs in the area.

Roosevelt elk herds continue to expand throughout the watershed. The majority of the area is summer range, and there is an abundance of forage intermixed with hiding and thermal cover. Elk harvests have been continuing to increase each year, sport hunting is the primary source of predation on elk populations.

Road density within the area is 3.1 miles per square mile (see **figure 20)**. This high level of roading eliminates habitat effectiveness for elk and deer by approximately 50%. Road closures mitigate the problem. Closed roads do not result in significant disturbances to deer and elk and are often used as travel corridors, and for foraging and bedding.

Pacific fisher, American marten and Northern goshawk inhabit the watershed. Neotropical bird species nest throughout the watershed. Knowledge of amphibian and reptile species and their status is limited, since no surveys have been conducted.

RECREATION

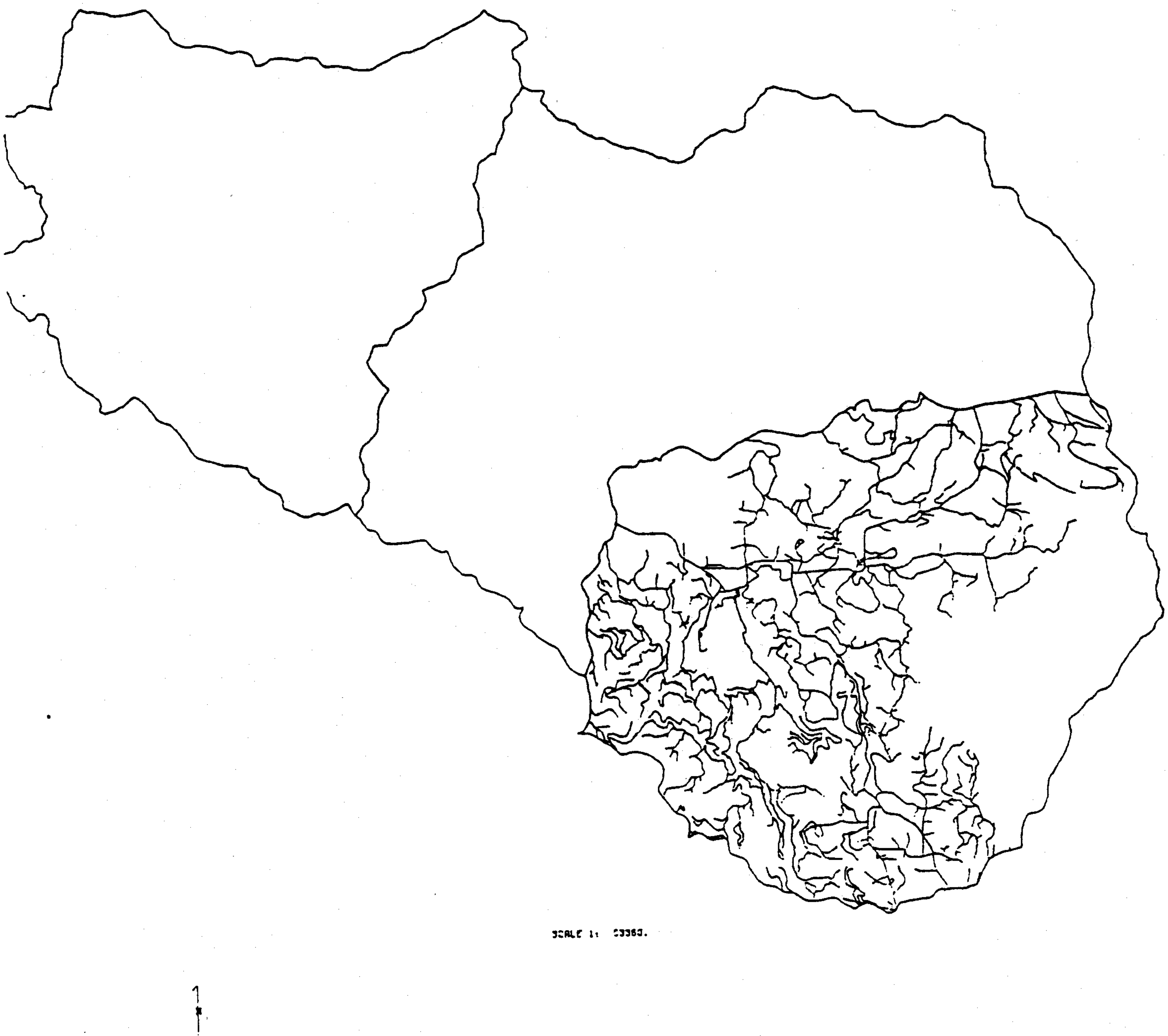
The resources within the watershed provide excellent recreational opportunities such as camping, fishing, hunting, sightseeing, hiking and boating. Willow Lake is the largest body of water, in the Watershed, providing most of the water recreation. Willow lake is suitable for waterskiing, fishing and boating and has lodging facilities and a campground.

Camping at the several developed campgrounds and dispersed sites is popular. Campgrounds usually fill during hunting seasons and on major holiday weekends. Forest road 3770 provides major access to the Sky Lakes Wilderness. Additional access is via the Twin Ponds trailhead (Forest Road 3760). Fishing is popular in the wilderness and in Fourbit Creek.

Various pools in the creeks are used by campers throughout the summer. Hiking and horse trails exist in the wilderness area, and in the vicinity of Willow Prairie. The Butte Falls Loop Tour is available as a self-guided auto tour through part of the Watershed. Winter recreation is limited, but cross-country skiing and snowmobiling opportunities exist.

Big Butte Watershed
Figure 20

ROADS FOR BIG BUTTE WATERSHED



TRANSPORTATION

The existing transportation system is adequate to meet the current public and administration needs and resource uses. New road construction may be needed for access and management of timber stands in some portions of the watershed. Most new roads would be short distances and of low standard construction or temporary in nature. The trail systems in the Watershed are adequate to meet the current demand. Additional horse trails may be needed in the future to meet demand in the Willow Prairie area. The Twin Ponds trailhead could be enlarged to accomodate horse trailers as demand increases.

SLOPE STABILITY

The primary mass-wasting processes in Big Butte Watershed are caused from raveling on steep slopes, earthflows in clay-rich soils and debris slides in or near steep drainages.

Earthflows and debris slides on the Watershed are primarily confined to the rocks of the Western Cascades and area surrounding Oak Mountain.

The Watershed was shaken in 1993 by two moderately large earthquakes (about 6.0 magnitude), which occurred near Klamath Falls. More quakes of this size can be expected.

The Watershed is traversed by the Mt. McLoughlin Fault Zone, a series of sub-parallel faults. Most of this zone is about six miles wide, extending through the Cascades on a line including Pelican Butte and Oak Mountain. This zone has not moved in modern times, but should still be considered active.

The South Fork of Fourbit Creek follows one of the faults associated with this zone. Fractured rock below ground may form a conduit allowing water from east of the Cascades (Four Mile Lake) to drain into the Watershed, via Four Bit Creek. Wetlands and ponds at the headwaters of Fourbit Creek are a result of this glacial and faulting history.

Recent studies have shown that every 300 to 500 years the entire Pacific Northwest west of the Cascades is shaken by a 9.0 earthquake. Most structures (including Willow Lake dam) were built before quakes of this size were known to have occurred in this area and may not be constructed to withstand the event.

CHAPTER 4 - REFERENCE CONDITIONS

Original forests consisted of open stands dominated by more drought-resistant ponderosa and sugar pines; Douglas-fir and true firs remained clustered in riparian areas and on shady north slopes and at the higher elevations.

Prior to the establishment and protection of the Forest Preserves at the turn of this century, Native Americans, trappers, miners, and homesteaders had a profound effect on the fire regime. The Native Americans gathered berries and medicinal plants and burned for hunting, berries and roots yearly. The regular burning by Native American tribes and lightning fires helped retain the optimal density of the forest trees and maintained the pioneer and early seral species such as the pines in the stand composition. Beginning in the 1820's, Hudson Bay Company trappers used fire indiscriminately to drive game, miners used fire to rid the woods of pests and expose rock outcrops, and homesteaders utilized fire to assist in clearing their land.

In a report prepared by Levi Harper Mattox in 1888, the largest trees that grew in the region were sugar pines, reaching 50 feet or more in height before the first limb and six to eight feet in diameter. The timber in the region had scarcely been touched at the time and extended continuously as a magnificent forest of pines, firs, hemlocks and other conifer species.

Fourbit Creek originates on the side of Mt. McLoughlin, winding for several miles through a swamp. It was estimated to be ten feet wide, and three or four feet deep, with a sandy bottom and crystal clear water. Apparently there were fish in the river and also in the high lakes of what is now Sky Lakes Wilderness. In the 1880's, cougar, lynx, grizzly bear, and the gray wolf were present in the Watershed.

In the very early days of white settlement in the Rogue River Valley cattle raising was important. The greatest enemy of the cattle was grizzly bears, which were quite numerous and frequently came down from the mountains for cattle. Additionally, there was an abundance of pheasants in the lower portion of the Watershed. Apparently the deer population was good, coming out of the mountains into the lower portion of the Watershed with the onset of winter. No mention was made of elk (ref. Mattox 1888).

Wildlife management focused primarily on big game and predator management throughout the early 1900's . Elk were re-introduced to Crater Lake National Park, eventually populating the entire province. Elk have now almost reached carrying capacity within the Watershed. Cougar populations were hunted to very low levels until the State of Oregon designated them as a game species. Black bear were hunted as a game animal, but little is known about the early status of this species.

In the late summer the forest becomes very dry and forest fires were frequent historically. These fires apparently burned uncontrolled and during the latter part of the summer there was a pall of smoke. Usually the sun would not shine until about ten in the morning and would disappear about two in the afternoon. There were a few days that the sun did not shine at all through the smoke. This happened every summer during the period the author (Mattox) lived near the Watershed.

Harvesting as practiced in the period of the 1880s through the mid-1940's tended to selectively remove first the dominant, large-diameter sugar pine and ponderosa pine and, later in the period, the dominant Douglas-fir. Harvesting produced large timber and what remained tended to be inferior trees which had been long suppressed in the understory --- generally white fir.

Homesteaders would select large diameter sugar pine to make high quality shakes and shingles. Homesteaders also cleared land for their cabins, barns and orchards, but these areas were relatively small in size due to the great amount of effort to fell large conifers with only an axe.

The Forest Service (Crater National Forest) first appraised the timber stands of the Big Butte Watershed in 1909, updating the appraisal in 1917, and making a report in January, 1920. The report was to promote the area for development and to encourage that a railroad system be built into the area to facilitate harvest of the timber. An investor was found to bid on the timber and begin constructing a railroad into the Big Butte Watershed in the 1920s. Between 1925 and 1932 nearly 100 million board feet of timber was harvested from the Fourbit Creek drainage. During this time all snags were felled as a matter of practice. Ten ton tractors were utilized to skid out the felled timber to the waiting railcars. Slash was piled by the tractors but not always burned. Burning of piles tended to be done immediately adjacent to the rail lines to minimize the fuels hazard in the area. It was intended to leave at least 15% of the original stands (10" Dbh and greater) in the Fourbit Creek drainage. However, the amount of dwarf mistletoe (witches brooms) infection and amount of disease in the vast tract of overmature Douglas-fir and ponderosa pine gave foresters of the era great concern so trees with those indicators were removed.

Again from the Mattox report: "on the narrow gauge railroad, freight cars were loaded with magnificent sugar pine logs. The once almost untouched forest had been ruthlessly destroyed. No effort was made to get rid of the unsightly brush and stumps. All that appeared to be of concern was getting the timber out." This was true of other places in the west witnesses on that trip by Mr. Mattox.

Following World War II harvesting became less discriminant with the post-war building boom. Diameter-limit cuts were prevalent throughout the 1940s and 1950s and tended to promote a more even-aged condition by taking all larger diameter trees. In some stands these trees occur in two or three age classes; the origin of each age class followed a fire or other major disturbance, such as a windstorm or tree harvest.

Reforestation was by natural seedfall until sometime in the 1930s when limited artificial reforestation was attempted through broadcast seeding and the placing of small seed caches protected from the rodents and birds. Reforestation using nursery seedlings began in the 1930's (CCC's), when a series of reforestation projects in burned over areas began. The CCC's used non-local sources of ponderosa pine and fir, which introduced new gene pools to the local ecosystem. In order to insure success of these plantations, strychnine baiting stations were established to control porcupine and squirrel populations. Secondary impacts occurred to non-target animal species.

Reforestation efforts began in earnest in the late 1940's when harvesting increased to a point where natural regeneration could no longer be relied upon to keep up with the rate that openings were created in the forest. Stocking was not always known and was often not from local seed sources. This has led to some second growth stands not producing at the level expected by the site potential. Road building began in earnest at this time as well.

By the 1970s two-stage shelterwood harvesting was the preferred silvicultural treatment with some underplanting where natural regeneration was unreliable. Harvesting since the mid-1970's has shifted away from even-aged management to more uneven-aged or selection harvesting.

Another forest practice which impacted the ecosystem has been the use of herbicides such as Tordon, which was used in the Cat Hill burn area in the 1960's and 1970's.

Natural and person-caused fire has shaped vegetation succession within the Watershed. Low intensity fires, both lightning caused and those set by Native Americans, burned periodically throughout the summer and early autumn within the Watershed. Fires burned every 15 to 30 years mainly along the ground rather than in tree crowns. These fires perpetuated the open park-like Ponderosa and sugar pine stands dominating the landscape near and around Fourbit Creek. Due to fire frequency, fuels were consumed leaving what can be described as light loading of needles and small limbs. Small amounts of large woody material were present on the forest floor. Low volume of fuel accumulation did not create conditions favorable for stand replacement fires. Fire as a disturbance mechanism was not as catastrophic during the prehistoric time period as it is today due to fire exclusion and resulting buildup of fuels. The potential exists for large stand replacement fires when drought, high temperatures and windy conditions exist.

Fire severity is more varied at higher elevations due to additional moisture and shorter growing seasons. Low intensity ground fires along with high intensity crown (stand replacement) fires occurred. These fires produced a mosaic forest of various ages and densities. Fuels were generally heavier than those at low elevation due to lack of consumption from frequent ground fires. Forests were more resistant to insects and disease than the dense stands that dominate these sites today.

Settlement brought about fire suppression in order to protect homesteads, grazing lands and timber resources. Fire frequency decreased dramatically; however, the Cat Hill fire of 1910 was a 30,000 acre stand replacement event. This fire occurred in the northeastern side of the watershed and extended from the flats around Whiskey Springs into the current Sky Lakes Wilderness Area.

CHAPTER 5 - INTERPRETATION

HYDROLOGIC RESOURCE

The upper portion of the Big Butte Watershed is one of the most intensively managed pieces of land on the Rogue River National Forest. There has been timber harvest activity on this Watershed for at least 75 years. Extensive road construction in support of the timber harvest has had a major effect on the surface character of the Watershed. The entire upper portion of the Watershed on National Forest land has been grazed by domestic livestock. Even with all of this disturbance, the Watershed has continued to function well hydrologically. Water quality remains high, stream flows are good, stream channels are in fair to good condition. Water yielded by Big Butte Springs (BBS) continues to be of extremely high quality, and quantities are remarkably steady. The long history of land management has not had an adverse effect on water quality in Big Butte Springs. This is one of the most important consideration for this Watershed; therefore it can be said that the Watershed is in good health.

Generally, the Watershed is able to handle storm events without problems. Flows in Big Butte Springs are very steady. There has been a response in recent years to the below-normal rainfall amounts, but even with this, flow remains good.

Intense rainstorms and rain-on-snow events can produce enough surface water runoff to erode soils. Where slopes are gentle and infiltration rates are high, eg., Skeeter Creek subwatershed, such storm events cause little erosion. However, on steeper slopes in the Willow Creek subwatershed, there is a greater likelihood of erosion from storms. The natural conditions in Willow Creek subwatershed have been exacerbated by logging and related road construction. Roads typically disturb large amounts of earth during construction. They also reroute natural drainage patterns and often put large amounts of water into drainages.

Flood events are infrequent in this Watershed and there is little channel erosion. A more complete inventory of stream channels should be conducted within the Watershed to identify erosion problems.

The character of the Watershed throughout the primary infiltration zone and elsewhere is highly permeable. This results in a difficult cleanup in the case of a contamination or spill. The permeable surface allows for fast and wide pollutant dispersal, and difficult excavation due to the hard rock surface. The permeability places the Watershed in a relatively high risk category for contamination due to pollution and flooding. Many of the concerns and risks of contamination to the groundwater system can be minimized by site-specific mitigation measures.

The greatest risk of surface water entering the Big Butte Spring system is in the high infiltration zone. Surface water from this entire area has the potential to enter the groundwater system via the highly permeable High Cascade lava. Skeeter swamp, and the two square mile area immediately west of the swamp are examples of this permeability. Pollutants gaining access to Willow Lake via stream inflow, or otherwise, could pass through the lake and infiltrate into the groundwater system through downstream seepage loss zones.

Soil infiltration studies done in conjunction with the Big Butte Springs Watershed Geohydrologic Report (1990) revealed that two-thirds of the Watershed has surface infiltration rates between 3 and

24 inches per hour. High infiltration rates like these clearly indicate the potential for pollution of the spring system.

The principal effect that erosion and slope failure could have on water quality or supply is the creation of turbid water flow in the streams draining the Watershed. The likelihood of turbid flows is greatest in the (Western Cascades) Willow Creek basin. Willow Lake does mitigate this potential by acting as a sediment trap so the hazard to the water supply is low.

Soil compaction is a concern in the Watershed. Once compacted, it is nearly impossible to return clay soils to a non-compacted state. Much of the Watershed has been tractor logged and early logging did not utilize the strict mitigation measures which recent harvesting has employed. Subsoiling compacted clay-rich soil breaks the soil into clods that, when wet, flow back into a semisolid mass.

There is a noticeable lack of large down woody material in the Watershed. The functions of large wood in the riparian areas are multiple -- wildlife habitat, aquatic habitat, channel stability, and streambank stability. Processes that deliver large wood to riparian areas are primarily natural. Wind throw, natural aging of trees, occasional channel erosion or landslides all cause trees to topple over into the riparian areas and stream channels.

Water has been diverted from Big Butte Springs on a constant basis since 1922, and probably much longer. This diversion has reduced the amount of water and the quality of water downstream in Big Butte Creek.

A one tree-height riparian reserve should be sufficient in width to protect hydrologic values in most streams within the Watershed. Exceptions are in the Willow Creek subwatershed on the Western Cascades geology and in some other locations where with local instability problems. In those instances, maintain reserve widths of greater than one tree-height. The current health of various components of the riparian areas in the Watershed is unknown. Local considerations for determining riparian reserve widths for hydrologic purposes are: slopes into the channels, distance to the nearest slope break, width of the channel, stream shading needs, large woody material needs, erodability of the soil next to the stream and in the adjacent watershed, and type of vegetation. Other factors may also be important and should be considered on a site-by-site basis.

Ultimately, the management practices used to protect water quality in the Watershed have been successful, and ought to be continued. The water quality in the Watershed ought to be monitored to insure continued success.

RELATIONSHIP OF VEGETATION TO THE ENVIRONMENT

Stands developing after major disturbances are often described as "even-aged", since all component vegetation has been assumed to regenerate shortly after the disturbance. In reality vegetation continues to regenerate for several decades following a disturbance before available growing space becomes fully utilized. This results in a wide age range for the stand. Trees regenerating after a single disturbance may have an age range as narrow as one year or as wide as several decades depending on the length of time for trees to invade following a disturbance. This is called the stand initiation stage.

A major disturbance radically changes the forest floor and soil environment even if it does not destroy them. The natural processes for soil development are interrupted and nutrients are lost. Species composition of a stand is largely the result of the type and severity of disturbance as some species have a competitive advantage over others. Soil, climate, available sunlight, moisture and nutrients influence which species have a competitive advantage.

The stand initiation stage is characterized by very high numbers of plant species. It is also a period when many animals are found, since the variety of plants and seeds provides an abundance and diversity of food.

After several years, no new individuals appear and some of the existing ones die. The survivors grow larger and express differences in height and diameter; first one species and then another may appear to dominate the stand. This is the stem exclusion stage. Once the available growing space is re-occupied, new individuals do not become established successfully. Those plants with a competitive advantage in size or growth pattern are able to expand into growing space occupied by other plants and reduce their growth rate or survival. A given stand may have only parts of it in this stage and may take several decades before all parts make the transition from the stand initiation stage to the stem exclusion stage.

The foliage layer rises as the trees grow taller, and leaves cannot survive in the diminished sunlight beneath it. Plants which cannot grow tall enough to stay within the uppermost foliage layer often die. The shaded forest floor becomes devoid of living plants and consists of dead and decaying leaves, stems and twigs.

Later, during the understory reinitiation stage, forest floor vegetation and advance tree regeneration again appear and survive in the understory, although they grow very little due to reduced resources such as sunlight, soil moisture and nutrients. These are species capable of living in low light conditions and can be the same species as the overstory and those shrubs and herbs which grew during stand initiation, but they are often not. Species favored in the understory at this stage in this watershed are white fir, western hemlock and mountain hemlock.

The understory reinitiation stage generally contains more animal species than does the stem exclusion stage, but fewer than the stand initiation stage. Understory plants generally contain less starch nutrition for animals than those growing in full sunlight. Many animals are particularly adapted to growing in this stage and in the subsequent old growth stage, during which they utilize the woody debris built up on the forest floor for food and shelter. A large animal population can prolong the time before the understory reinitiation stage appears by browsing forest floor vegetation while it is very small.

Much later, overstory trees die in an irregular fashion, and some of the understory trees begin growing into the overstory. This 'old growth' condition is achieved by a unique development sequence and has various diameters and ages of trees in the stand. When the trees which invaded immediately after the major disturbance have all died, the stand enters a true old growth condition. When young trees first grow into the overstory while some relic trees from a previous disturbance remain alive this condition is referred to as transition old growth.

The term "old growth" has also been used to describe stands with specific structural characteristics. Structural features include large, living old trees; large, dead standing trees; massive fallen logs; relatively open canopies with foliage in many layers; and diverse understories. Such structures are achieved by a variety of major and/or minor disturbance patterns. Through stand management, old growth structures can be created much more quickly than through natural processes.

The old growth stage probably has the greatest horizontal and vertical variation in structure, with both large and small trees growing in separate and intermixed patches. The number of plant and animal species found is generally more than in the stem exclusion or understory reinitiation stages but less than in the stand initiation stage. A few plants and animals are survive on the rotting wood or large limbed nesting trees found exclusively in these old growth forests.

Stand management accelerates development of the "natural direction" of a forest, and also alters or omits some components or processes that may otherwise have occurred, including additional disturbances. Silvicultural treatments are prescribed in accordance with the stages of stand development. By utilizing natural stages of development, some management activities, such as the need for artificial regeneration, can be avoided.

Fires and insect attacks tend to occur during the stem exclusion stage; activities such as thinning can reduce or increase the risk of fires or insects. Progressively older stands become more susceptible to windthrow as the trees grow taller. Maintaining a closed canopy at the end of the rotation will retard the encroachment of competing vegetation that would otherwise be a problem in the subsequent rotation.

Severe competition from sedges and grasses often inhibits seedling establishment and growth in the Watershed. Heavy equipment used for logging often aggravates the sedge competition problem. It will be increasingly important to monitor the successes of 'new forestry' practices regarding stand development and competing vegetation. Managers need to assess site-specific conditions and propose actions that meet Forest Plan standards and guidelines.

Given enough time, and without major disturbances, mountain hemlock and white fir will replace Douglas-fir and western white pine in the true fir-hemlock stands. Western hemlock, white fir and incense cedar will replace Douglas-fir, sugar pine and ponderosa pine in the mixed conifer stands.

Not managing stand densities will invite insect epidemics and accelerated mortality, thereby increasing fuel loading and fire risk. Not managing stand densities will also promote the shift of stand composition away from shade intolerant species toward shade tolerant species such as true firs (white fir and Shasta red fir), hemlocks (western hemlock and mountain hemlock), and to some degree Douglas-fir.

Natural plant communities and plant associations are best able to withstand drought and natural attacks by fire and insects. Therefore, managers should attempt to mimic natural conditions where possible.

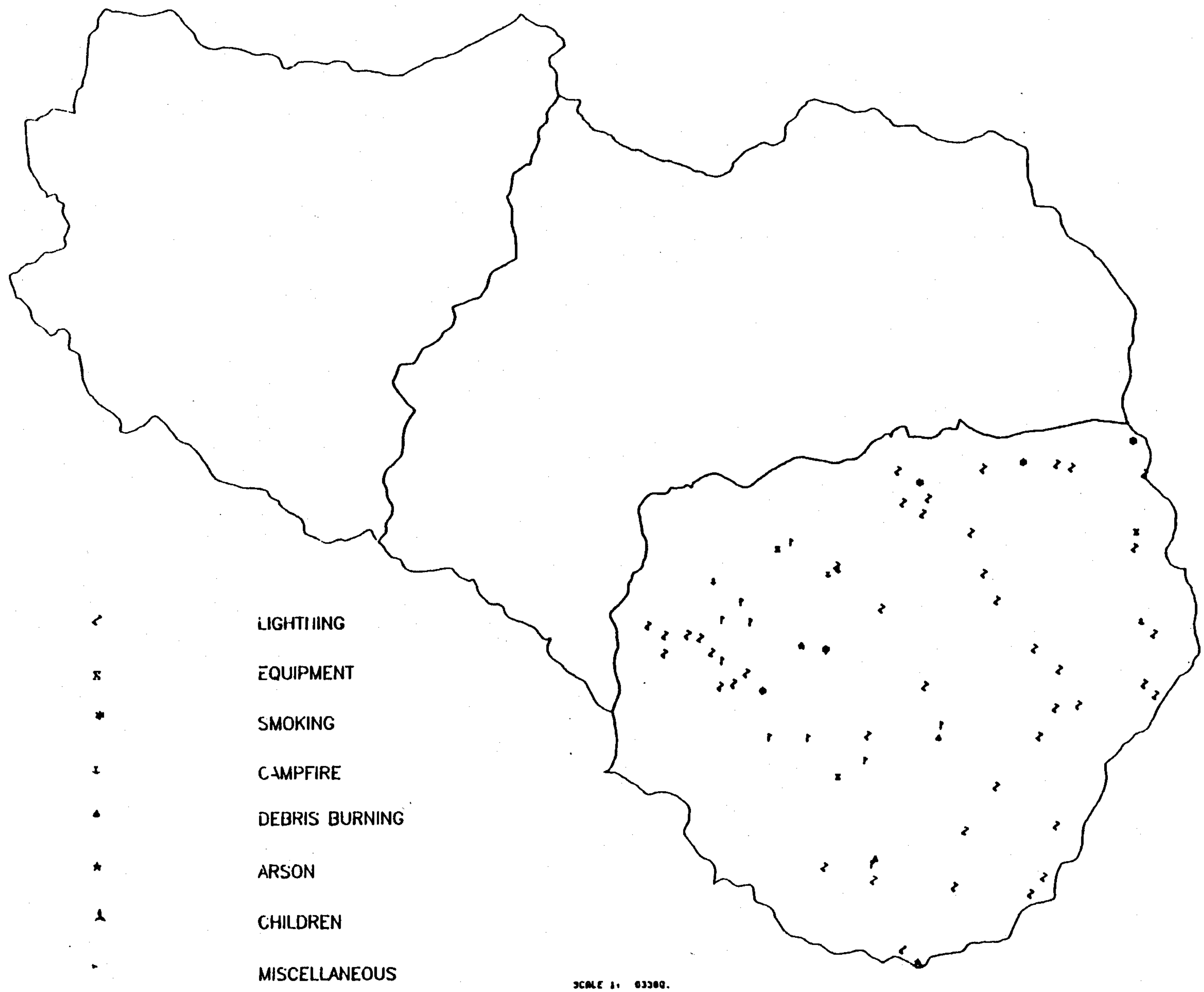
Prescriptive fire can be utilized as a management tool to maintain or improve the health of the ecosystem if used with the knowledge of the plant association appropriate for the site. But even prescriptive fire should be used judiciously. It is important to maintain mycorrhizae, which aid plants in the uptake of nutrients and water and assist seedling survival and development.

As the demand for forest products continues to grow and the acreage available for commercial forestry shrinks, forest management practices will need to intensify. Care will be needed to maintain or improve site productivity on areas designated for commercial wood production.

FIRE IMPLICATIONS

From 1960 to 1992 there have been 15 fires in the 5900-acre high occurrence area, thirty fires in the 34,000 acre low occurrence area, and 25 fires in the 16,000 acre medium occurrence area of the watershed (**see figure 21**).

FIRE OCCURRENCE FOR BIG BUTTE WATERSHED



Computerized simulation (BEHAVE program) was done on a landscape basis using slope and fuel models generated by the GIS system. BEHAVE outputs show there are 35,218 acres of low hazard, 3378 acres of moderate hazard and 3089 acres of high fire hazard in the Watershed.

In order to assess fire potential on this Watershed, fire risk (occurrence) and fire hazard (behavior) were combined. The following are the results:

	Acres
Low hazard - Low Risk	18,769
Low hazard - Med Risk	13,251
Low hazard - High Risk	3,198
Medium hazard - Low Risk	2,330
Medium hazard - Med Risk	791
Medium hazard - High Risk	257
High hazard -Low Risk	0
High hazard - Med Risk	0
High hazard - High Risk	0

This Watershed does not include areas of high hazard and high risk due to generally moderate topography. However, a catastrophic stand replacement fire could occur when the right conditions exist, as evidenced by the 30,000 acre Cat Hill fire of 1910. It is unknown what effect a fire of this magnitude would have on water quality at the Big Butte Springs.

WILDLIFE

Wildlife populations have been significantly altered in the Watershed from reference conditions. Timber harvesting, road construction, water diversion, use of pesticides, and human recreational use (hunting in particular) are the major agents of change for wildlife species. Regionally, migratory species are affected by circumstances that are beyond the scope of this document.

Cattle grazing is another factor influencing the ecosystem. Livestock grazing appears to be at or near projected carrying capacities on the Fish Lake allotment. No updated analysis has been done on the Rancheria allotment, but it is estimated that numbers are below carrying capacity.

The habitat for black tail deer and elk in the Watershed is at an optimum and good forage conditions should continue under the matrix designation in the ROD. Riparian corridors will continue to provide migration routes, thermal cover and calving/fawning areas.

Road density within the Watershed is 3.1 miles per square mile and should be reduced. Closing roads is an option since closed roads do not negatively effect elk and deer movements.

THREATENED, ENDANGERED AND SENSITIVE SPECIES

The bald eagle pair at Willow Lake appears to be successfully breeding. Their habitat is good. The presence of, and habitat for, Sandhill cranes may be higher than historically. The reproductive capability of the cranes nesting in the area is questionable due to grazing, roading and recreational activities in the area. Populations of foraging bats are suspected to be smaller than historical levels due to human impacts at roosting sites. Spotted owls are at risk and may be extirpated from the Watershed.

RECREATION

The resources within the Watershed provide excellent recreational opportunities such as camping, fishing, hunting, sightseeing, hiking and boating. Willow Lake is the largest body of water, providing most of the water recreation. Willow Lake is suitable for waterskiing, fishing and boating and has lodging facilities and a campground.

Camping at the several developed campgrounds and dispersed sites is popular. Campgrounds usually fill during hunting seasons and on major holiday weekends. Forest road 3770 provides major access to the Sky Lakes Wilderness. Additional access is via the Twin Ponds trailhead via Forest road 3760. Fishing is popular in the wilderness and in Fourbit creek.

Various pools in the creeks are used by campers throughout the summer. Hiking and horse trails exist in the wilderness area, and in the vicinity of Willow Prairie. The Butte Falls Loop Tour is available as a self guided auto tour through the Butte Falls district, including part of the Watershed. Winter recreation is limited, but cross country skiing and snowmobiling opportunities exist.

TRANSPORTATION

The existing transportation system is adequate to meet the current public and administration needs and resources uses. The trail system in the Watershed is adequate to meet the current demand. Additional horse trails may be needed in the future to meet demand in the Willow Prairie area. The Twin Ponds trailhead could be enlarged to accomodate horse trailers as demand increases.

CHAPTER 6 - RECOMMENDATIONS

Fire / Fuels Recommendation:

* The higher fire hazard and fire risk zones should receive top priority for hazard or risk reduction. Prescribed fire should be applied under the correct conditions, and is a necessary tool to maintain stand health. Fire can be used to enhance wildlife forage, reduce buildup of fuels, and control stand density.

* Reintroduce fire where appropriate based on site specific analysis. Fire should be allowed to play its natural role in the Sky Lakes Wilderness portion of the Big Butte Watershed.

* When applying fire in the Watershed consider the water quality effects that surface runoff may have in Willow Creek drainage and in the critical infiltration areas of Big Butte Springs.

* Verify fuel models based on fire behavior predictions.
* Base fire protection efforts on:
  * Maintenance of facilities (Helispots, water sources, and fuel breaks).
  * Maintain suppression crew capability.
  * Strengthen prevention efforts at Willow Lake, Fourbit, Snowshoe, Whiskey Springs and Willow Prairie Campgrounds.
* Manage prescribed burns in accordance with Smoke Management Guidelines.
* Maintain primary and secondary roads where needed for fire access.
* Map fuel hazard based on aspect, slope, fire occurrence and plant association.

Vegetation:

* An indepth study of the growth and yield projections of managed lands on the Watershed is needed. Verify the projected timber yields from established plantations which will provide part of the volume obligations of the Rogue River National Forest in the future.

* Invest additional efforts to optimize management objectives, and employ appropriate harvest and reforestation methods. The following are recommended activities:

  1. Carefully conduct harvesting and reforestation practices:
     a. Utilize proper harvesting procedures;
     b. Implement adequate and appropriate site preparation;
     c. Promptly reforest following harvest and site preparation;
     d. Use vigorous, well-adapted genotypes for reforestation;
     e. Carefully plant or seed from improved seed sources;
     f. Protect stock from pests (insects, big game, rodents), diseases and fire;
     g. Monitor site productivity, brush competition and conifer survival and growth.

  2. Control competition:
     a. Anticipate weed problems before they develop;
     b. Select appropriate vegetation management strategies;
     c. Implement correct weed control techniques;
     d. Monitor treatment results.

3. Utilize stand management practices:
    a. Maintain stocking control (precommercial and commercial thinning);
    b. Fertilize (natural and artificial);
    c. Protect stands from pests (insects, big game, rodents), diseases, fire and physical damage (mechanical damage during thinning).

4. Monitor, Research and Develop:
    a. Refine current technology and information;
    b. Assist to develop improved silvicultural practices;
    c. Utilize advances in predictive capabilities and biometrical practices;
    d. Study role of mycorrhizae, and how natural fire and ground disturbing activities affect their effectiveness.
    e. Integrate systems management.
    f. Update stand condition database and GIS mapping.
    g. Update the harvest unit GIS map and database.
    h. Continue stand condition monitoring beyond stand establishment including growth data.

Hydrologic Resource:

* A riparian reserve vegetation condition study is needed. An indepth study over approximately a five year period would answer many questions regarding terrestrial, aquatic, invertebrate species, vegetative conditions, and the processes affecting all of these.

* There is no up-to-date inventory of watershed restoration needs within the watershed. There are undoubtedly watershed restoration needs within the Willow Creek watershed. Most of these are thought to be associated with the extensive roading and logging within this area. An inventory of watershed improvement needs should be completed for the entire watershed, but should begin with Willow Creek Watershed.

* What water quality information there is indicates that harvest of trees along streams has not caused noticeable lowering of water quality. However, this is not known as a certainty. It has not been quantified how much of the land identified by the Northwest Forest Plan as riparian reserves has been managed. It is unknown what the impact of these entries on channel geometry and aquatic habitat is. A more certain statement can be made with respect to Big Butte Springs. After decades of land management, there has been no lowering of water quality at the springs.

Plant Species (Monitoring and survey needs):

* GIS mapping of rare plant species designated by population polygons.
* GIS mapping of past surveys and survey intensity levels by year and surveyor.
* ONHP data base sort of specific site information about population.
* GIS map update with field collected plant association information.
* GIS update of stand vegetation, harvest data and plantation condition.

* Survey and manage for (FSEIS Appendix J) species.
* Collect and consolidate data from the Oregon Natural Heritage Program, and Herbaria.
* Continue to gather information about the species present in the watershed.
* Assemble a working guide with information and illustrations that will help botanists to locate and identify these species and make sound management decisions.

Recreation:

* Pursue completion and designation of snowmobile opportunities in the Rustler Peak and Blue Rock area.

Wildlife:

* Maintain adequate dispersal habitat for northern spotted owls throughout the area.

* Maintain fifty percent of the area with at least 40 percent canopy closure and stands of trees averaging greater than 11 inches DBH for dispersal habitat.

* Conduct presence/absence studies for California wolverine.

* Conduct presence/absence studies and habitat use studies for northwestern pond turtles.

* Monitor habitat use of sandhill cranes. Improve habitat in breeding areas.

* Conduct surveys for survey and manage bat species. Follow up 1976 surveys.
* Utilize protocol for red tree voles and survey for presence or absence.

* Survey for presence or absence of pygmy nuthatches.

* Gate or berm new roads to mitigate degradation of Roosevelt elk and blacktail deer habitat. Insure existing closures are maintained year around.

* Create forage for big game using prescribed fire, timber harvest and brush removal.

* Continue surveys for fisher and martin. Expand PNW furbearer study to the Butte Falls district.

* Survey for goshawks using standard survey protocol.

* Continue to operate Skeeter Swamp MAPS station for at least 5 years.

* Survey for presence or absence of amphibian and reptile species suspected of inhabiting the watershed.

* Update Allotment Management Plans for the Fish Lake and Rancheria allotments.

* Complete Late Successional Reserve (LSR) Assessment for all subwatersheds in Big Butte Watershed.

* Maintain Northwest forest Plan designated two tree height riparian reserve buffers on all fish-bearing streams and one tree height buffers on non-fish bearing streams. Survey all streams in the watershed to accurately assess which portions are fish-bearing and which are not.

* Reduce road density where practical, placing abandoned roads back into production.

* Inventory Riparian Reserves for dependent species occurrences.

Geology and Soils:

* Mitigate soil impacts such as compaction, displacement and channeling (see mitigation procedures outlined in Chapter 8 of the Big Butte Springs Geohydrologic Report).

* Maintain soil productive potential and ability to handle precipitation without eroding or resulting in cumulative effects off-site.

* Avoid reactivation of ancient landslides during new management activities.

* Monitor the effects on soils (compaction in particular) from past and current management activities to determine if standards and guides are met.

* Prepare and implement site-specific restoration projects for adversely impacted soils.

* Design and maintain road surfaces and drainage structures to produce minimal erosion.

* Update slope stability mapping and soil resources inventory.

* Reclaim the two depleted quarries on National Forest land.

* Armor existing and planned road surfaces and drainage structures on sensitive soils and/or unstable lands.

* Improve long-term recruitment of large woody material (LWM).

* Consider re-establishment and growth potential before implementing additional projects on south-facing droughty soils.

CHAPTER 7 - KEY QUESTIONS AND ANSWERS

TERRESTRIAL SYSTEMS

I. Vegetation:

a. What is the current vegetation and stand condition within the watershed?

Shasta red fir, Pacific silver fir and western hemlock are adapted for establishment and growth in small openings. Douglas-fir, ponderosa pine and sugar pine are well adapted to large openings, created by wildfire, extensive windthrow, flooding, timber harvesting, or agricultural cultivation. Incense cedar and white fir are also well adapted to openings.

b. What special habitats, exotic and non-native species, and locally rare and endemic species are present in the watershed?

Many of the rare plant populations that exist in the Big Butte Watershed are found in unique areas such as rock outcrops or scablands, and are generally not in conflict with forest management or recreation activities. Rare plants are also found in wetlands, seeps and moist meadows. Without human intervention, many of these populations would naturally be rare due to evolutionary development of the species.

Past habitat modification throughout the Big Butte watershed may have contributed to the decrease or to the decline of certain species through changes in soil, moisture, or light.

II. WILDLIFE

a. What wildlife species inhabit the watershed and what processes affect their welfare?

A list of known or suspected species which inhabit the Big Butte Watershed is contained in the appendix. The list is not a complete list. No surveys have been conducted to verify presence or absence of all species listed. Each species or group of species has a unique set of requirments which affect their welfare. Some species, such as the northern spotted owl, have well documented requirements for survival. The vast majority of species have not been studied in enough detail to fully understand which processes affect their overall welfare.

b. What wildlife species recognized as in peril (T,E & S) are present in the Watershed and how does the Watershed provide habitat for those species relative to their entire range?

No endangered species are known to reside in the Upper Big Butte Watershed. Peregrine falcons may utilize the area for foraging, but no documented sightings exist. Threatened species include the northern spotted owl and one bald eagle pair. Seven spotted owl pairs have been located. All seven pairs home ranges exceed "Take" thresholds, indicating that spotted owls within the Watershed are at risk.

Gray wolves and grizzly bears, both on the Federal endangered list, are considered extirpated from the State, and were once common in this Watershed.

Several sensitive species occur within the Watershed: California wolverine, northwestern pond turtle, greater sandhill crane and pacific western big-eared bats.

A list of candidate species which may be found on the Rogue River National Forest is located in the appendix.

III. LANDSCAPE PATTERNS

a. How does the geology of the Watershed influence other elements such as water quality (sediment delivery to aquatic habitats) and presence of special habitats (cliffs, seeps, etc) in the Watershed?

The Watershed is traversed by the Mt. McLoughlin Fault Zone, a series of sub-parallel faults. The majority of this zone is about six miles wide, extending through the Cascades on a line including Pelican Butte and Oak Mountain.

The geology of the Watershed is volcanic in nature. The High Cascades makes up the majority of the Watershed. The Western Cascades terrain is far more unstable, and slopes are often steep and soils erosive. The base of the High Cascades rests on the Western Cascades and is a chain of broad, overlapping, slightly domed shield volcanos, overlain by very porous and more recent andesite lave that resulted in prominent peaks called composite volcanos, like Mt McLoughlin. The geologic features are the foundation for the hydrologic features in the Watershed. This results in high quality water at Big Butte Springs. The high quality water has been a major influence in the development of the landscape since the early 1900's.

Most of the soils are derived from the volcanic rocks of Mt. McLoughlin. Soils are shallow and are limited in water holding capacity. Soils are droughty during the dry summer months. Soils in the High Cascades are less erosive than soils in the Willow Creek subwatershed. Soils in the Willow Creek subwatershed are higher in clay content, have a greater water holding capability, and are more susceptible to mass movement.

b. How have the geology and natural processes in the Watershed affected the status of soils and soil productivity?

Erosion, mass movement, channel downcutting, and ravelling are all natural processes that have occurred and influences soils and productivity. Another important factor in the development of soils and resultant productivity is the presence of organic debris, which decomposes into soil through natural processes involving moisture, fungus, insect and animal life, mycorrhizae, and time. Large woody material and presence or absence of natural or prescribed fire are especially important. Removal of timber (large woody), ground disturbance from road building and harvesting, and resultant compaction and displacement of fine soil particles are the most impacting effects to soil productivity resulting from past management practices in the Watershed.

c. What historical disturbance and natural processes (grazing, harvesting, roading, fire, geologic processes, insect and disease) and what effects on (species, vegetative structure changes, compaction, sedimentation) components and processes have occurred?

The vegetative characteristics have changed considerably due to timber harvest, fire control, ranching, and roading. The overall impacts of these changes are not known due to a lack of information on the current status of most species found on the watershed. The processes and resultant conditions in the watershed are significantly different than would be present without modern human impacts. A vegetative structure and resultant plant and animal communities resembling todays older multi-layered stands with large woody material and snags would likely be present.

d. How is the current landscape pattern different than would be expected under the natural disturbance regime?

Under a natural disturbance regime, the mosaic pattern would occur in much larger patches, resulting mainly from wildfire. Patches would be at various ages and stages of development. Some areas would be in early regeneration due to more recent wildfires. There would be a significant greater amount of old growth stands and dependant wildlife species. Species dependant on early seral stages would be less prevalent. Stands and habitat types would be more contiguous, and would not be bysected by roads. Natural predator/prey processes would occur.

AQUATIC SYSTEMS

IV. WATER QUALITY

a. Is there evidence of reduced water quality in the watershed and what types of water quality impacts are associated with activities in the watershed?

Monitoring at Big Butte Springs by the Medford Water Commission over a thirty year period shows that water has been remarkably consistent and of high quality. Water quality impacts are mainly related to sedimentation and displacement resulting from road construction and ground based logging. Intense rainstorms and rain-on-snow events can produce surface water runoff that can erode soils and affect water quality for short durations. This is especially true for Willow Creek subwatershed. Conditions in Willow Creek subwatershed have been exacerbated by logging and related road construction. Where slopes are gentle and infiltration rates are high, as is the case in much of the watershed, Skeeter Creek subwatershed in particular, there is little erosion or displacement.

V. AQUATIC SPECIES, HABITAT AND POPULATIONS

a. What is the historic and current habitat condition, life history, populations and distribution of fish and other aquatic organisms and aquatic species at risk?

A complete list of species, habitat, habitat condition and life history of aquatic species is not available at present. An insufficient number of surveys have been conducted to verify presence/absence or habitat conditions. Each species or group of species has a unique set of requirments which affect their welfare and have not been studied in enough detail to fully understand which processes affect their welfare.

b. What wildlife species recognized as in peril (T,E & S) are present in the Watershed and how does the Watershed provide habitat for those species relative to their entire range?

No endangered species are known to reside in the Upper Big Butte Watershed. Peregrine falcons may utilize the area for foraging, but no documented sightings exist. Threatened species include the northern spotted owl and one bald eagle pair. Seven spotted owl pairs have been located. All seven pairs home ranges exceed "Take" thresholds, indicating that spotted owls within the Watershed are at risk.

Gray wolves and grizzly bears, both on the Federal endangered list, are considered extirpated from the State, and were once common in this Watershed.

Several sensitive species occur within the Watershed: California wolverine, northwestern pond turtle, greater sandhill crane and pacific western big-eared bats.

A list of candidate species which may be found on the Rogue River National Forest is located in the appendix.

b. What are the historical conditions, current conditions and desired future conditions contributing to water quality and ecosystem health in riparian areas?

The water quality in the Watershed is directly related to the geology and topography of the Watershed. Riparian areas have been altered significantly during the past due mainly to timber harvesting and roading activities. Some water development for cattle and pumper shows has interrupted stream flows but does not affect water quality. There are a few minor water diversions in the watershed such as at Whiskey Springs. The removal of 26 million gallons of water per day from Big Butte Springs certainly affects the portions of Butte Creek below the Springs. Willow Lake is the largest impact to the natural conditions of a riparian area in the Watershed.

Riparian Reserves are a critical part of the President's Forest Plan and for appropriate stream protection. A survey for fish and aquatic habitat, and for blockages to fish passage and stream characteristics is needed. Appropriate riparian reserve widths as specified in the President's Forest Plan would follow the determination of fish presence. In order to modify widths, following a watershed analysis, information about the riparian dependent species (the "survey and manage" species) needs to be gathered. In a lot of instances, nothing is known about these species.

The desired characteristics of the riparian reserves (desired future conditions) need to be specified in a inter-disciplinary team environment. Once this is done, appropriate management techniques could be prescribed to achieve these conditions. As a minimum, the desired future condition of the riparian areas would be to function in their natural role in the ecosystem. Water quality would remain consistently high. Aquatic and fish habitat and species populations would regain historic levels.

SOCIAL SYSTEM

VI. PUBLIC USES

a. What resources (water, timber, firewood, wildlife, sand, cinders etc.) used by humans have been extracted from the ecosystem in the past and at what magnitude?

Medford Water Commission has removed 26 million gallons of water per day (about 40 CFS) since 1927.

It is estimated that 100 million board feet of timber was logged from the Fourbit Timber sale between 1928 and 1932. Since that time an additional estimated 200 million board feet of timber has been logged from the various sales in the Watershed. An estimated average of 200 cords of fire wood per year has been cut since the 1960's, with lesser amounts prior to that. Sport and subsistance hunting in the Watershed has occurred in historic times and recently, mainly for deer and elk.

There are three rock quarries owned by MEDCO in the Watershed;

NE 1/4, Sec 22, T 36 S, R 3 E.	5,000 cubic yards available
SW 1/4, Sec 36, T 36 S, R 3 E.	60,000 cubic yards available
NW 1/4, Sec 10, T 36 S, R 3 E.	275,000 cubic yards available

There are five active quarries or pits administered by the USFS.

SE 1/4, Sec 20, T 36 S, R 3 E.	15,000 cubic yards available
SE 1/4, Sec 21, T 36 S, R 3 E.	20,000 cubic yards available
SW 1/4, Sec 17, T 36 S, R 3 E.	8,000 cubic yards of sand is available
NE 1/4, NW 1/4, Sec 22, T 36 S, R 3 E.	100,000 cubic yards of cinders available.
SW 1/4, SE 1/4, Sec 30, T 35 S, R 3 E.	100,000 cubic yards available.

There are two depleted quarries on Forest Service administered land. Neither have been reclaimed.

b. What ability does the Watershed have to provide for past and current uses and what type and intensity of recreational use (wilderness access, hunting, trapping, camping, fishing, hiking and sight seeing) is occurring in the Watershed?

The Watershed continues to be able to provide the resources that it has in the past. Timber harvest levels have dropped and will remain low for up to twenty more years in order to meet the standards and guides of the ROD and Forest Plan. As second growth timber comes on line for regeneration harvest in Matrix land, harvest levels within the Watershed may approach four millian board feet (MMBF) annually for a period of years. The expected output in the Watershed for the next decade is expected to remain at about two MMBF annually.

The resources within the Watershed provide excellent recreational opportunities such as camping, fishing, hunting, sightseeing, hiking and boating. Willow Lake is the largest body of water, providing most of the water recreation. Willow Lake is suitable for water skiing, fishing and boating and has lodging facilities and a campground. Camping at the several developed campgrounds and dispersed sites is popular. Campgrounds usually fill during hunting seasons and on major holiday weekends. Forest road 3770 provides major access to the Sky Lakes Wilderness. Additional access is via the Twin Ponds trailhead via Forest road 3760. Fishing is popular in the wilderness and in Fourbit Creek.

Various pools in the creeks are used by campers throughout the summer. Hiking and horse trails exist in the wilderness area, and in the vicinity of Willow Prairie. The Butte Falls Loop Tour is available as a self guided auto tour through part of the Watershed. Winter recreation is limited, but cross country skiing and snow mobiling opportunities exist.

The Watershed is fully capable of withstanding higher levels of recreation activity than what is occurring at present, especially winter recreation activities such as snow sports.

c. Does the existing transportation system (roads, trails) serve the current and future needs?

The existing transportation system is adequate to meet the current public and administration needs and resources uses. New road construction may be needed for access and management of site specific timber stands in some portions of the Watershed. Most new roads would be short distances and low standard construction. Trail system in the watershed is adequate to meet the current demand. Additional horse trails may be needed in the future to meet demand in the Willow Prairie area. Twin Ponds trailhead could be enlarged to accommodate horse trailers as demand increases.

APPENDIX A

HYDROLOGY

INDEX TO APPENDICES

Big Butte Watershed Analysis

Hydrology Section

Introduction

There are few areas on the Rogue River National Forest managed as heavily as the Big Butte Creek watershed. From the early part of this century up to current times. the watershed has experienced heavy timber harvest. roading, development, and grazing. Yet through all of this activity, the watershed has continued to provide a reliable source of cold, extremely pure water for the Medford Water commission and it's 80,000 customers.

The upper portion of the Big Butte Creek watershed has many uses. Among these are timber. wildlife. recreation, grazing, and water production. The most important of these is the production of water for municipal purposes. The Big Butte Springs watershed is the largest municipal watershed in the Rogue River Basin and is the largest ground water source in the basin. It is one of two primary sources of municipal water for Medford. Central Point, Eagle Point. Jacksonville. Phoenix. and seven small water districts.. The system serves 80,000 people on a daily basis.

Big Butte Springs provides a steady supply of high quality water on a year-round basis. Average daily flows are about 26 Million gallons per day (about 40 CFS). Medford began using the water from Big Butte Springs as its sole source of municipal water in 1927. Two, thirty-one-inch pipelines carry water from the springs to Medford on a continual basis. For most of the year, water from Big Butte Springs provides for all of the water needs of the customers of the Medford Water Commission. During the summer when demand exceeds the supply from the springs, the City supplements the water from the springs with water from the Rogue River.

The U.S. Forest Service manages the majority of the lands within the upper Big Butte Creek watershed as a part of the Rogue River National Forest. Ownership of the 56,400 acres within the watershed is as follows:

Medford Water Commission	6.1 %
Rogue River National Forest	74.8 %
Bureau of Land Management	0.9 %
Medite Corporation	17.8 %
Boise Cascade Corporation	<1 %
Other Private	<1 %

Hydrography

The upper Big Butte Creek watershed is about 56,400 acres in size. This represents 36 % of the entire Big Butte Creek Watershed.

Flow from the upper watershed totals 116,600 acre-feet annually at Butte Falls. Total flow at the mouth of Big Butte Creek totals 201,400 acre-feet per year. The 58% of the total flow contributed by the upper watershed is more important than the volume of the water alone. It represents most of the really high quality water in the watershed. Temperatures are generally low. Studies by the Medford Water Commission show surface water quality is generally high. **(See Figure H6)**

There are about 97 miles of stream within the upper watershed. Slightly more than half of these streams are perennial. A breakdown of the streams by class shows the following:

Stream Class	Miles
I	11.45
II	21.68
III	16.94
IV	46.97

Stream density in the watershed is 1.23 mi./mi.^{2} This is lower than on much of the Rogue River National Forest. This reflects much of the geology of the area.

Hydrology

Runoff is not flashy due to the low stream density and the high infiltration rates in the area. Mean annual flow varies about three times (low flow to high flow) in upper Big Butte Creek. In other areas on the national forest, this variation in streamflow can be as high as 90 to 100 times.

Flows in Big Butte Creek generally follow precipitation patterns. Peak precipitation occurs in the months of November through March. Figure H1 shows the average monthly precipitation at Butte Falls. Stream flows lag behind the rainfall patterns by about a month. Flows generally peak in December and January. There is a secondary peak in stream flow in March-April when the winter snows begin to melt. Generally the highest flows occur in December and January and are a result of rain on snow events. Figure H2 shows the mean daily hydrographs for Big Butte Creek at its confluence with the Rogue River near McLeod and the South Fork at Butte Falls.. Compared to other watersheds on the Rogue River National Forest, storm events do not produce as large a peak flow in Big Butte Creek due to the high infiltration rates within the watershed and to the low stream density.

Flows in Big Butte Springs generally remain steady throughout the years. There has been a response to the low rainfall amounts in recent years. Flows in the springs during this period have dropped off about 10 CFS on a daily basis. Figure H3 shows the flows in BBS in recent years as compared to those in Big Butte Creek and the South Fork. They are very steady compared to the large changes in Big Butte Creek shown in Figure H2.

Climate

The climate of the upper Big Butte Creek Watershed ranges from warm and dry in the summer to cold and wet in the winter. Precipitation generally occurs as rainfall at the lower elevations throughout the year. During winter, at the higher elevations, snow is the predominant form of precipitation. Most (70%) of the precipitation occurs from November to March. Figure H4 is an isohyetal map of precipitation amounts within the watershed. In the past decade, the area has experienced droughty conditions. During this period of time, the cumulative shortage of precipitation has equaled the amount of rain that would normally occur over two years. This shortage of rainfall has shown up in decreased streamflows in the surface water streams in the watershed and in the flow from Big Butte Springs. For two of the past two years, rainfall has increased to near normal amounts and streamflows have responded accordingly. However, the flow from Big Butte Springs has not been as quick to respond as surface water streams and is only now showing some increased volumes.

Stratification of the watershed:

Hydrologically, the upper Big Butte Creek watershed can be stratified into three subwatersheds -- Willow Creek, Fourbit Creek, and Skeeter Creek. The Big Butte Springs Geohydrologic Report contains a thorough description of the geology of the watershed. Brief descriptions of these three areas follow.

Willow Creek Western Cascades geology dominates in this sub-watershed. Soils are higher in clay content and produce more turbid runoff during storm events than Fourbit and Big Butte Creeks. It is not unusual to see Willow Creek flowing with a slight milky color during much of the year. This color is due to the colloidal material eroded from the watershed. Water yield is about 0.9 CSM (cubic feet per second per square mile). This is 50% greater than the yield in Fourbit Creek. The higher water yields are an indication of a need for more frequent drainage culverts on road systems and for additional erosion control structures on land disturbing activities.

Fourbit Creek About half of the Fourbit Creek watershed is in the High Cascades Province and half in the Western Cascades. Runoff is much clearer than in Willow Creek due to the lower amounts of clay soils in the basin. Water quality is high and the water does not have the milky color associated with Willow Creek. Water yield is 0.6 CSM.

Skeeter Creek: This subwatershed is mainly in the High Cascades. There is no surface outlet for water within this watershed. The entire amount of water flowing in Skeeter Creek seeps into the ground below Skeeter Swamp. It is thought that this water emerges again at Big Butte Springs. Water yield from this basin is about 0.3-0.5 CSM.

The Geohydrologic Study completed in 1990 documented gains and losses from Willow and Fourbit Creeks. Since the losses were occurring near Big Butte Springs, the study raised the question of whether some of the water that seeps from these streams into the groundwater reservoir might be reappearing at Big Butte Springs. If this happens, then there is a possibility for pollution in the two streams to mix with the groundwater in Big Butte Springs. It was the thought of this mixing that led to the change in the boundary of the land classified by the Forest Service as the Big Butte Springs municipal watershed. A detailed discussion of the possible gains and losses occurring in the streams in the watershed is in the Geohydrologic Report, Chapter Four.

Water Rights

Subject to existing water rights on may 29, 1925, the City of Medford has been granted exclusive rights to use the waters in Big Butte Creek and its tributaries for municipal purposes. No one else may appropriate or be granted a permit to use any of the waters except as provided by Oregon statute and for the benefit of the City of Medford.

When Medford was granted exclusive use of the unappropriated waters in Big Butte Creek watershed, the State also provided for a use of 100 CFS by the Eagle Point Irrigation District. The diversion for this right is located just below the falls on Big Butte Creek at the town of Butte Falls. Part of the irrigation district's water right is for water from Big Butte Springs. In order to have exclusive use of this high quality water for municipal purposes, the City of Medford constructed a dam on Willow Creek and impounded water in Willow Lake. Water is stored and later released from this 8,200 acre-foot reservoir to supplement flows in Big Butte Creek for use by the irrigation district.

Diversions of water from Big Butte Creek for irrigation purposes accounts for the fact that the long-term average flow in Big Butte Creek is lower in the lower stream than in the upper portion of the watershed. Figure H2 shows this. In the months of July, August, and September, flows at McLeod are lower than for the South Fork at Butte Falls.

Water Quality Data

The greatest amount of information on water quality within the watershed has been collected on Big Butte Springs by the Medford Water Commission in compliance with the Safe Drinking Water Act. There is not much data for other streams within the watershed. The Forest Service has collected stream temperatures on Fourbit Creek in 1993 and 1994. Figure H5 shows the daily high and low temperatures for this site. These temperatures are generally very good and are an indication of two things. First, since stream temperatures rise in response to direct input of solar radiation, there is generally good shading of Fourbit Creek by streamside vegetation. Second, there is probably a fair input of cold groundwater from springs into the stream.

The Medford Water Commission has done some water quality monitoring on surface streams within the watershed. Figure H6 shows the result of this monitoring. Two things are of interest in this figure. One is the general increase in the various parameters downstream as compared to upstream conditions. This is due to increased dissolved minerals as the water moves through older rock types on its way downslope. Second, it the generally low amounts of dissolved minerals in the water. The water is of very good quality.

Monitoring data from the Medford Water Commission for Big Butte Springs documents the extremely high quality of the water in the Springs. Turbidities average less than one NTU on a daily basis. Water temperatures are usually in the range of 44 to 46 degrees Fahrenheit. Bacterial counts are extremely low. All of the chemical parameters also continually measure in low ranges. This accounts for the fact that Medford has only to add a small amount of chlorine to the water as it enters the pipelines. No other treatment is necessary for this water to meet the requirements of the Clean Water Act for drinking water quality.

Figure H7 shows some of the ranges in water quality parameters for Big Butte Springs over a period of thirty years. Water qulality has been remarkably consistent during this period of time. ..

Clean Water Act Information:

There are no water quality limited streams within the Big Butte Creek Watershed. The only problems identified in the 1988 Statewide assessment were in Willow Lake. The Atlas of Oregon Lakes indicates that there are very low concentrations of major ions in Willow Lake. Additionally, conductivity and alkalinity are lower than average for reservoirs in the Rogue River Basin. The lake is mesotrophic. The water quality problems were associated with drainage from the sewage system for the campground and recreation area into the Lake. This has led to algae blooms that have caused health problems in some swimmers. There was also a moderate problem with pesticides and excessive plant growth that impacted the beneficial uses of cold water fish and aesthetics.

Identified beneficial uses in the Big Butte Creek watershed are municipal, irrigation, stock watering, cold water fisheries, aesthetics, recreation.

Medford Municipal Watershed:

Big Butte Springs is the largest municipal watershed in the Rogue River Basin and is also the largest groundwater source. It is one of two sources f municipal water for Medford and surrounding communities. The system serves 80,000 people on a daily basis. The Medford Water Commission provides water for Medford, Central Point, Eagle Point, Jacksonville, White City, Phoenix, and several small water districts. The 26 Million Gallons per Day (MGD) that the springs supply is one of the communities most valuable and significant resources. Currently, the springs are the only source of water for these communities for about seven months per year. During the summer period of peak demand, the City supplements its water supply with water from the Rogue River.

Big Butte Springs discharges an exceptionally high quality water tat is consistently cold, clear, and low in mineral content. Natural chemical and physical characteristics place the spring water in the "pristine" classification. No man-made contaminants have ever been detected in this source. Spring flows are collected underground and require only minimal treatment (disinfection only) to meet all current water quality standards. It is the intent of the U.S. Forest Service to manage the national forest land within the watershed to continue this condition.

Currently, Big Butte Springs is classified as a groundwater source for municipal supplies. Pending amendments to the Safe Drinking Water Act could complicate watershed management strategies if the springs are reclassified as a surface water source. Geohydrologic uncertainties raise questions about surface water influences. Because of possible surface water influences, the City of Medford is vitally interested in all land management activities within the watershed. The possible influence of surface water is also the reason behind the enlargement of the watershed boundary from slightly more than 22,000 acres to the present size of 56,400 acres.

One aspect of possible surface water intrusion into the groundwater supply is associated with the occurrence of *Giardia spp*. While there has never been a documented case of Giardiasis from the Medford water system, the Medford Water Commission has long had a concern about possible contamination of the water supply by this intestinal parasite that is the cause of this disease. Warm-blooded animals carry *Giardia* in their intestinal tracts. Beavers are a common host of *Giardia*, but almost any mammal can be a carrier. In the past, there had been a concentrated effort to trap all of the beaver out of Skeeter Swamp. This has changed the character of the swamp by eliminating many of the ponds created by beavers. Much of the open water wildlife habitat that was once in Skeeter Swamp has disappeared with the removal of the beaver.

The selective trapping of beaver from the watershed has not, in the opinion of the Forest Service, had an effect on the presence of *Giardia* in the watershed. There are many more animals such as muskrat, mice, voles, etc. that are potential carriers remaining in the watershed. Dr. T.P. Kistner, a veterinarian, opined that the removal of beaver "could lead to a false sense of security as to the safety of Skeeter source water due to the various other animals in the watershed." The Forest Service staff will continue to work with the Medford Water Commission on this issue.

The Water Commission is concerned about water quality contamination from other than biological sources. In its Wellhead Protection Plan, the Commission identified possible sources of contamination as the result of human activities or as "acts of God." Human related sources of concern are: agricultural practices, fertilizers, forest practices, petroleum products, pesticides, minerals and mining, range, residential developments, recreation, septic and sewage, surface water impoundments, roads, wildlife. Natural hazards are drought, earthquake, fire, flood, and volcanic eruption. The Wellhead Protection Plan has rated each of these hazards according to risk of contaminating the water supply. Readers are referred to this plan for this the ratings.

Riparian Reserves:

The Northwest Forest Plan calls for riparian reserves along all streams and wetlands. A width of two tree heights (312 feet) around all fish bearing streams and one tree height (156 feet) along other streams is specified in the plan. Figure RRRR shows the extent of the riparian reserves in the GIS system. There are approximately 5,735 acres of riparian reserves identified. Timber management activities entered many of the riparian reserves. While most of the streams adjacent to harvest units were protected by a buffer of varying widths, few were accorded the widths suggested in the Northwest Forest Plan. Additionally, few of the other riparian reserve guidelines for protecting aquatic habitat were considered in management activities. The most recent Forest Plan for the Rogue River National Forest called for no-harvest buffers of 100 feet along all Class I, II, and III streams.

One tree-height should be sufficient width to protect hydrologic values in most streams within the watershed. Exceptions are in the Willow Creek subwatershed on the Western Cascades geology and in some other locations where there are local instability problems. In those instances, maintain reserve widths of greater than one tree-height Local considerations for determining riparian reserve widths for hydrologic purposes are: slopes into the channels, distance to the nearest slope break, width of the channel, stream shading needs, large woody material needs, erodibility of the soil next to the stream and in the adjacent watershed, and type of vegetation. Other factors may also be important and should be considered on a site-by-site basis.

In its Wellhead Protection Plan, the Medford Waters Commission called for buffers of varying widths adjacent to surface waters within the watershed. For streams with perennial flow, the Water Commission called for buffers ranging from 100 to 300 feet in width. The Commission specified 75-foot buffers on all intermittent streams and for 100 to 300-foot buffers adjacent to Willow Lake and springs, ponds, and wetlands. These buffers are within the guidelines specified in the Northwest Forest Plan.

Interpretations:

The upper portion of the Big Butte Creek watershed is one of the most heavily "managed" pieces of land on the Rogue River National Forest. For at least 75 years, there has been timber harvest activity on this watershed. Extensive road construction in support of the timber harvest has had a major effect on the surface character of the watershed. The entire upper portion of the watershed on national forest land has been grazed by domestic livestock. Even with all of this disturbance, the watershed has continued to function well hydrologically. Water quality remains high, stream flows are good, stream channels are in fair to good condition although a more complete stream survey should be conducted to confirm this. Water yielded by Big Butte Springs continues to be of extremely high quality, and quantities are remarkably steady. The long history of land management has not had an adverse effect on water quality in BBS. Since this is the most important consideration for the watershed, the watershed is in good health.

Generally, the watershed is able to handle storm events without problems. The large area of high cascade geology has high infiltration rates. Most of this water is entrained in the groundwater system and does not show up as increased peak flows. Flows in Big Butte Springs are very steady. There has been a response in recent years to the below normal rainfall amounts, but even with this, flow remains good.

Concerns within the watershed begin with protection of the source of Medford's water. The MWC is concerned about the increasingly stringent drinking water quality standards. The Forest service should keep this in mind when planning activities within the watershed.

Information Needs

There is no up-to-date inventory of watershed restoration needs within the watershed. There are undoubtedly watershed restoration needs within the Willow Creek watershed. Most of these are thought to be associated with the extensive roading and logging within this area. An inventory of watershed improvement needs should be completed for the entire watershed, but should begin with Willow Creek.

How much of the land identified by the Northwest Forest Plan as riparian reserves has been entered by timber harvest activity. What has been the impact of these entries on channel geometry and on aquatic habitat?
Harvest of trees along streams has not caused noticeable lowering of water quality. However, this is not known as a certainty. What little water quality information there is indicates that this is the case. A more certain statement can

be made with respect to Big Butte Springs. After decades of land management there has been no lowering of water quality at the outlet of the springs.

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Reference:

Atlas of Oregon Lakes

KEY QUESTIONS

1. What are the natural processes which deliver sediment to aquatic systems and where do these processes occur within the watershed?

> Intense rainstorms and rain-on-snow events can produce surface water runoff that can erode soils. Where slopes are gentle and infiltration rates are high, i.e., Skeeter Creek Watershed, there is little erosion from such storm events. However, on steeper slopes such as in the Willow Creek watershed, there is a greater likelihood of erosion from storms. The natural conditions in Willow Creek watershed have been exacerbated by logging and related road construction. Roads typically disturb large amounts of earth during construction. They also reroute natural drainage patterns and often put large amounts of water into drainages not suited to handle it.
>
> Flood events are infrequent and there is little channel erosion within the watershed. There should be a more complete inventory of stream channels within the watershed to look for erosion problems.

2. What effect have management activities (such as timber harvest and road construction activities, and activities on private land) had on upslope processes that deliver sediment to aquatic systems?

> See above. Roading, rerouting of water through surface drains on roads, interruption of subsurface water movement, and erosion from the road template have all increased the amount of surface erosion and sedimentation.

3. Is there evidence of reduced water quality in the watershed?

See discussion above in the Water Quality section. There are no "water quality limited streams" as defined by the Clean Water Act within the watershed. Water quality in Big Butte Springs remains high. There are some water quality problems in Willow Lake.

4. What other types of potential water quality impacts may be associated with human and animal activities in the watershed?

See the discussion of the Medford Water system above. Answers to this question can be found there and in the Medford Water Commission's Wellhead Protection Plan.

5. What are the functions and processes that deliver large woody material to the riparian areas?

The processes that deliver large wood to riparian areas are primarily natural. Wind throw, natural aging of trees, occasional channel erosion or landslides all cause trees to topple over into the riparian areas and stream channels.

The functions of large wood in the riparian areas are multiple -- wildlife habitat, aquatic habitat, channel stability, streambank stability.

6. What resources (water, timber, firewood, wildlife, sand, cinders, etc.) used by humans have been extracted in the past and at what magnitude?

Water has been diverted from Big Butte Springs on a constant basis since 1922 and probably much longer. This diversion has reduced the amount of water and the quality of water downstream in Big Butte Creek. Since 1954, the water from Big Butte Springs has been replaced at least partially by releases from Willow Lake. While this helps make up the volume being diverted at Big Butte Springs, it is of lower quality than what comes from the springs.

The City of Medford, through the Medford Water Commission, diverts about 26 MGD (40 CFS) on a continual basis for municipal and industrial supplies.

Figures

Average Monthly Precipitation

Butte Falls

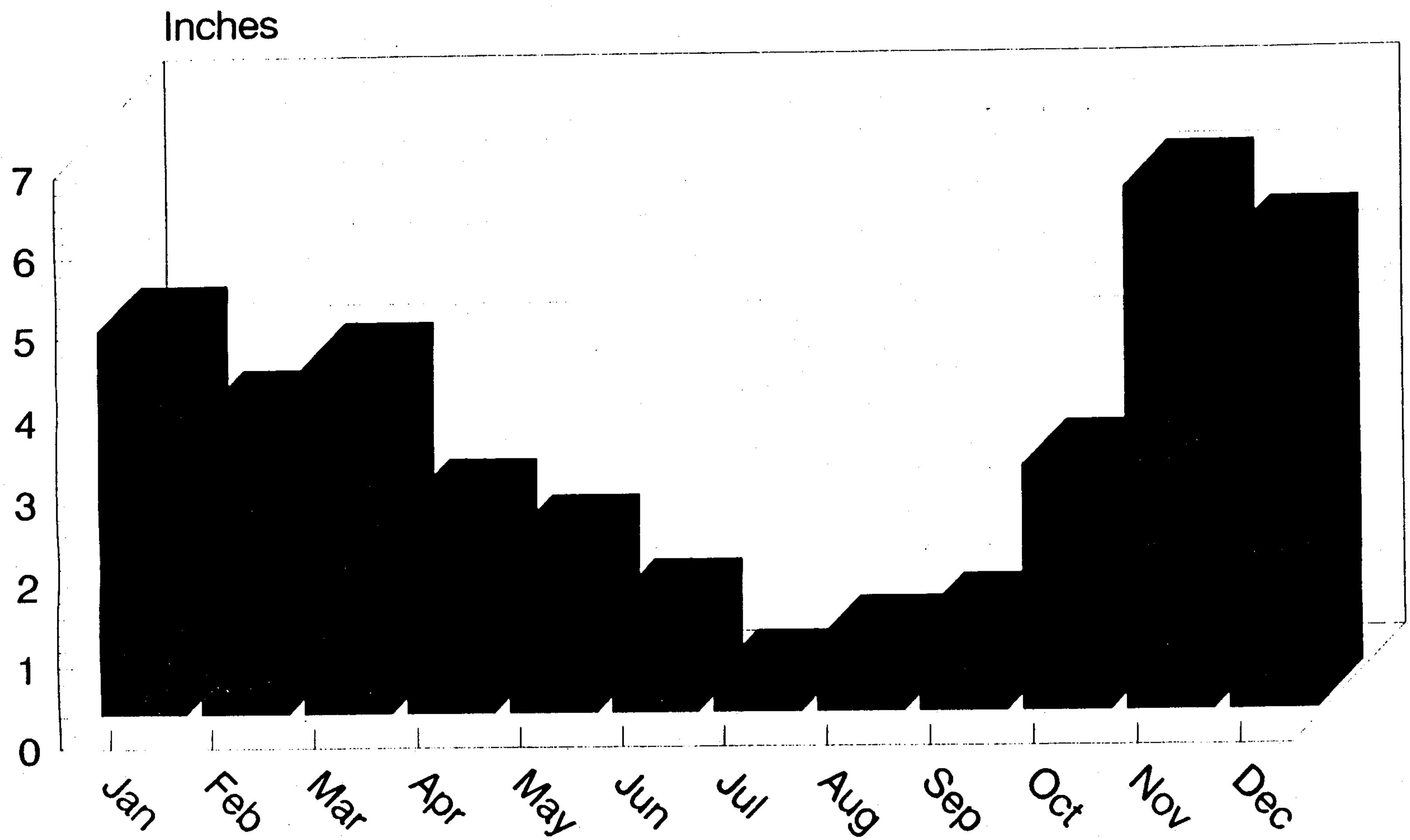
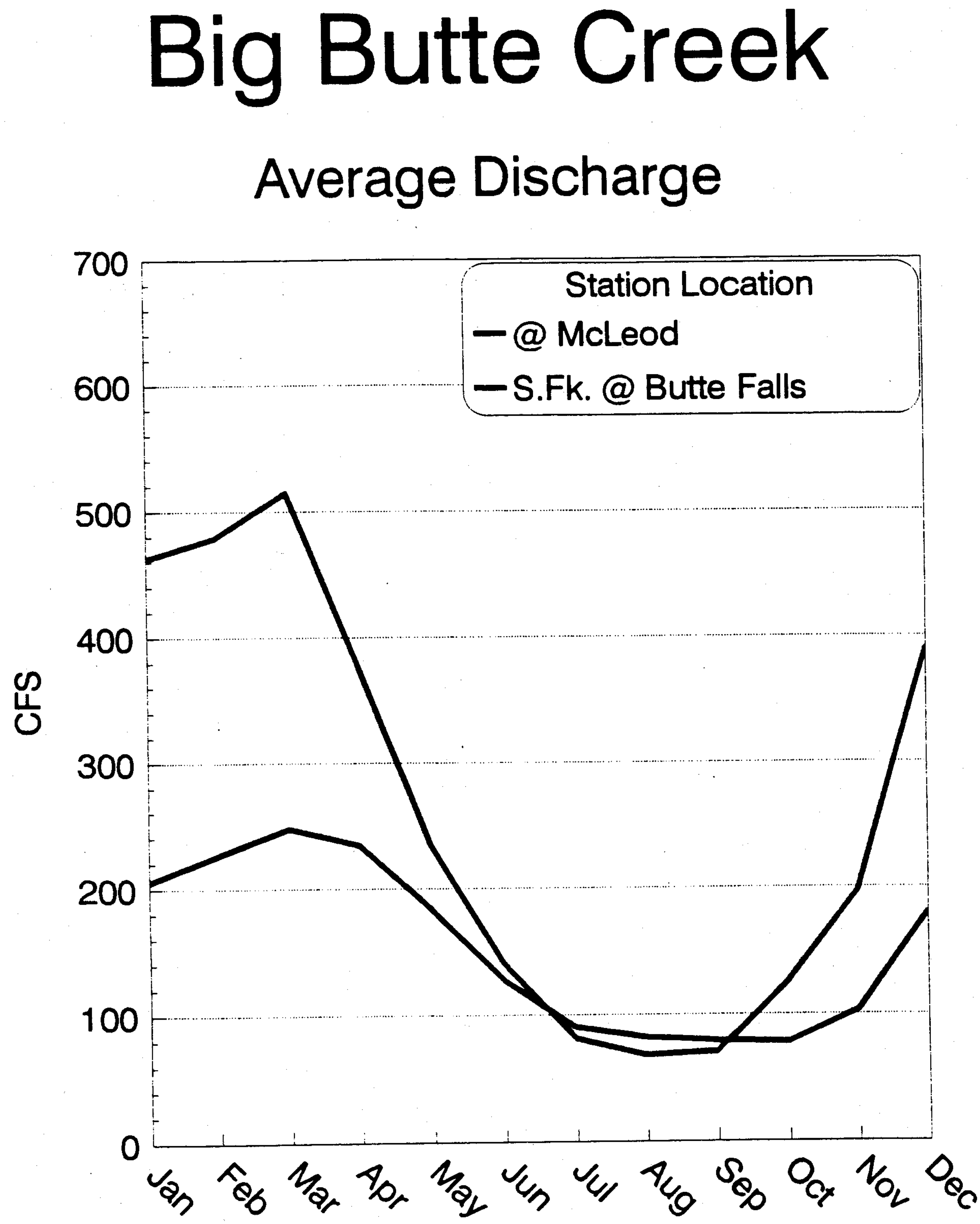


Figure H1



Big Butte Creek
Average Discharge
Station Location
@ McLeod
S.Fk. @ Butte Falls
CFS
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Figure H2.

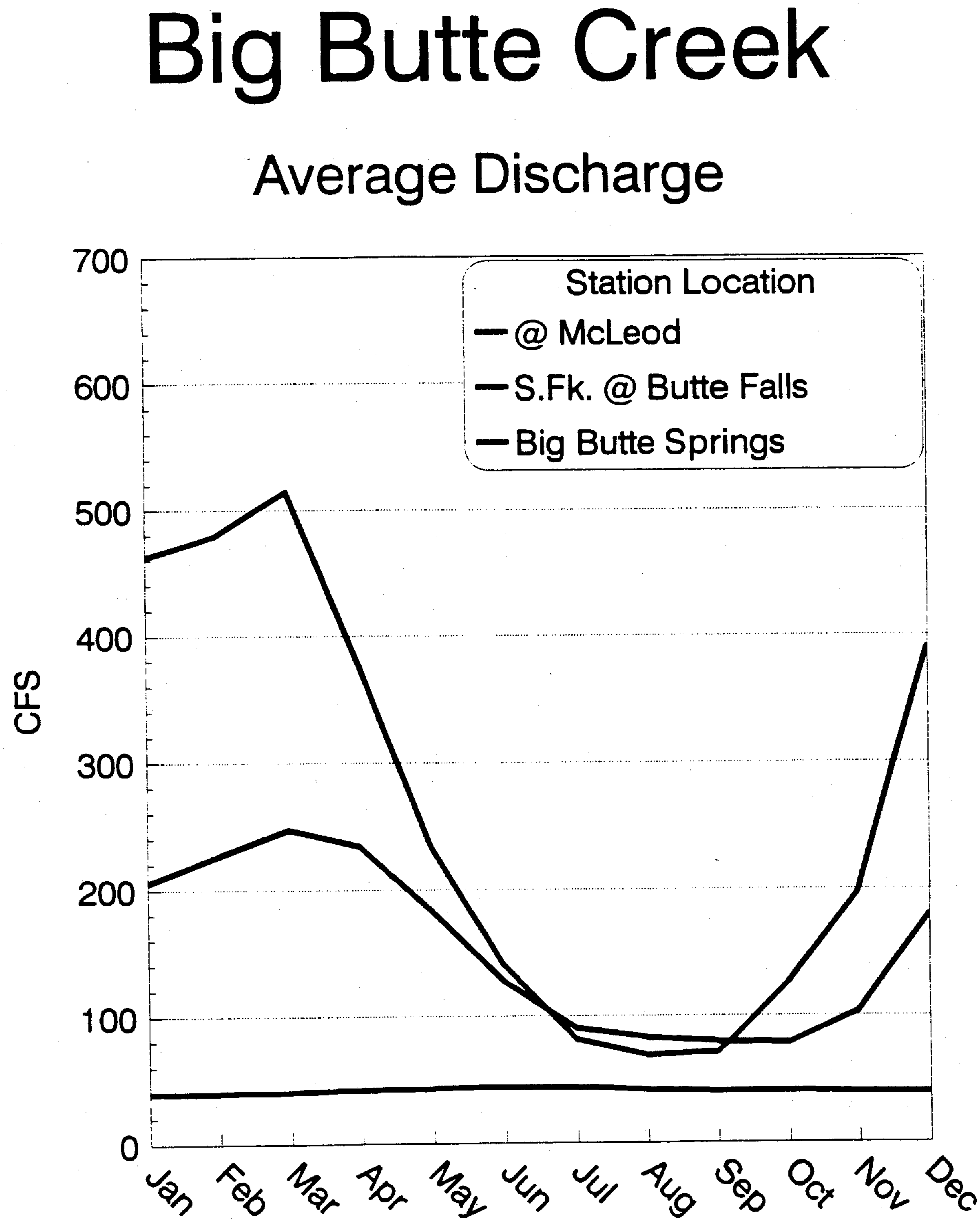
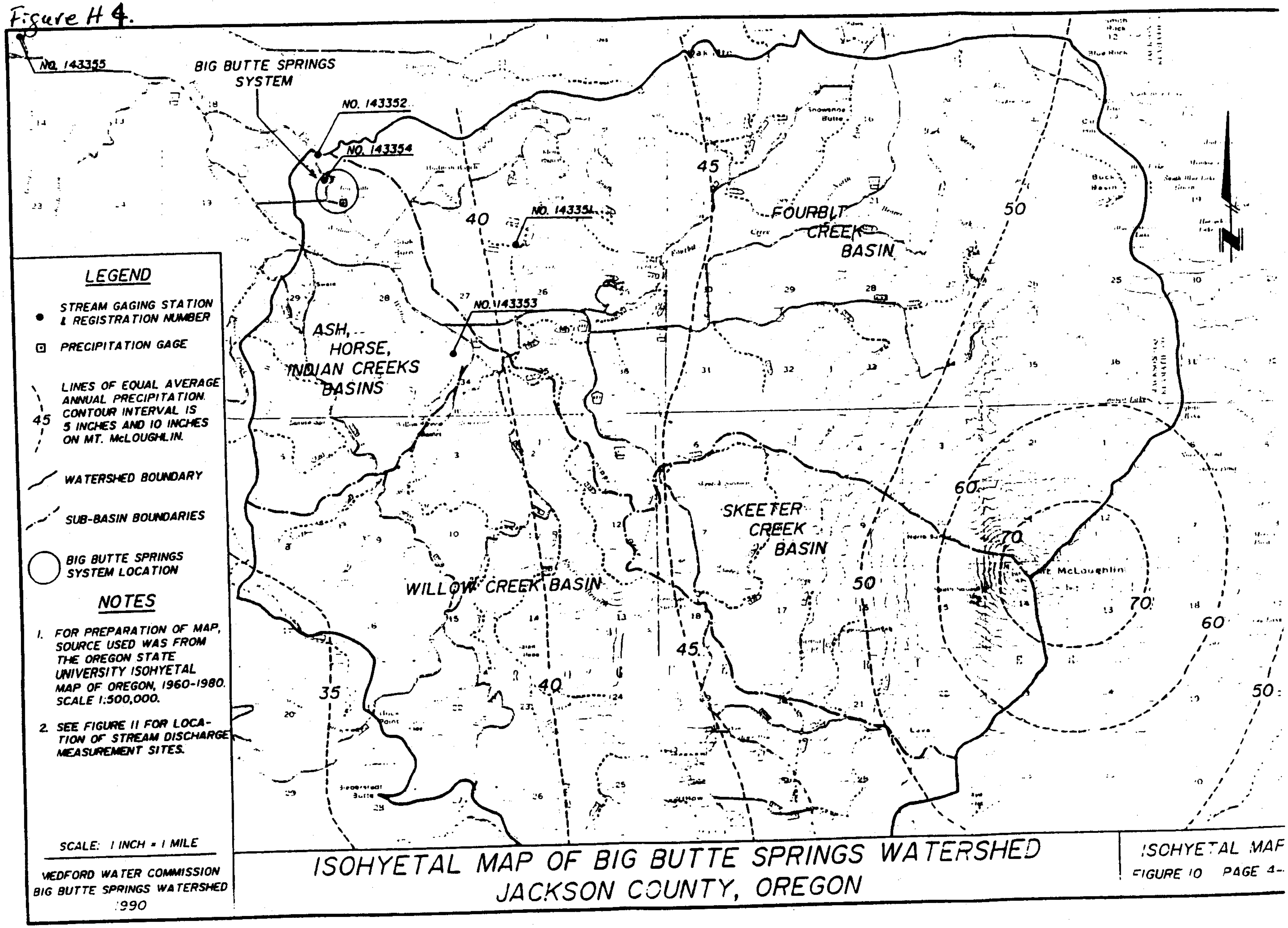

Big Butte Creek
Average Discharge
Station Location
@ McLeod
S.Fk. @ Butte Falls
Big Butte Springs
CFS
700
600
500
400
300
200
100
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

Figure -3

//

Figure H 4.



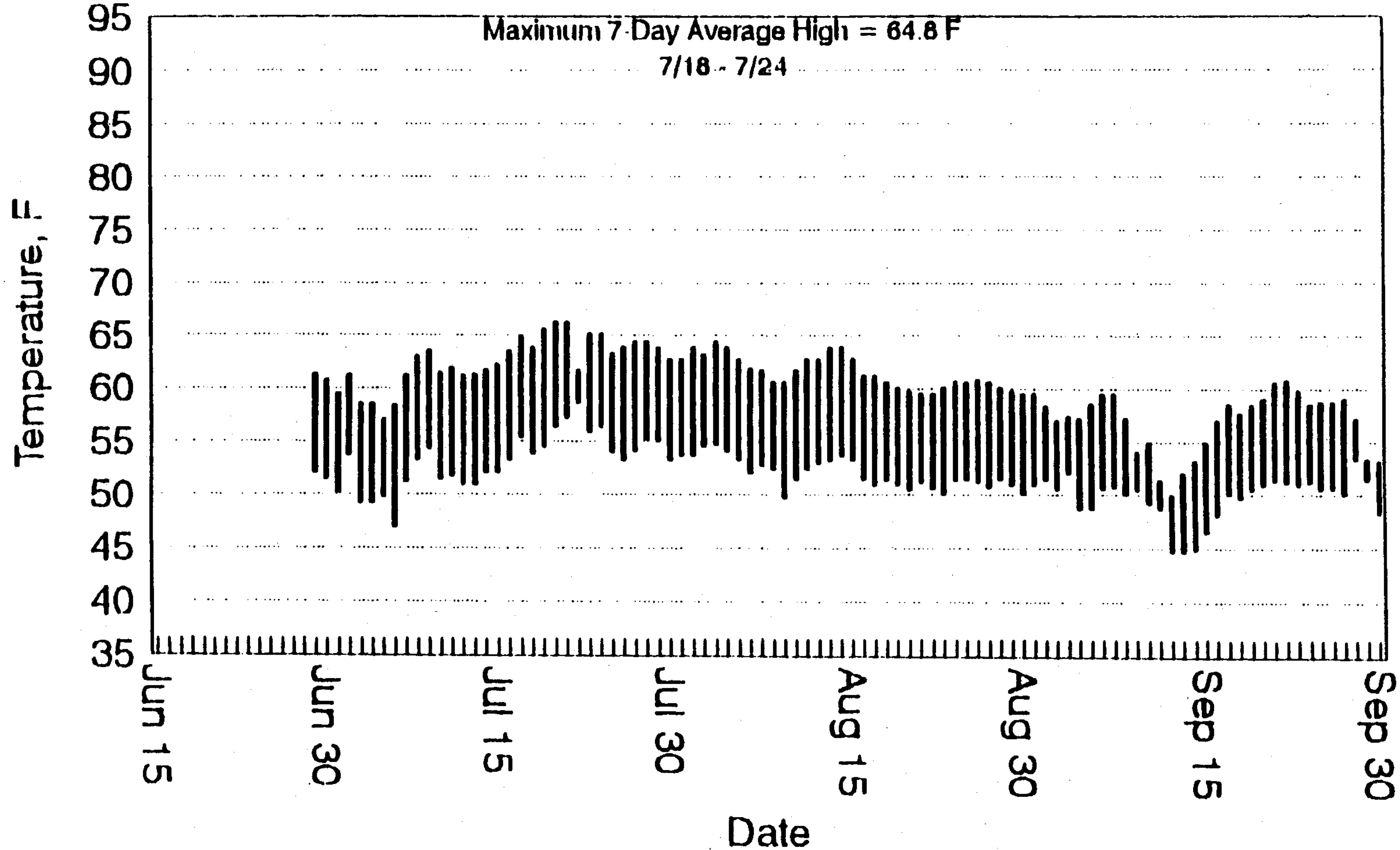
ISOHYETAL MAP OF BIG BUTTE SPRINGS WATERSHED
JACKSON COUNTY, OREGON

ISOHYETAL MAP
FIGURE 10 PAGE 4-

H5

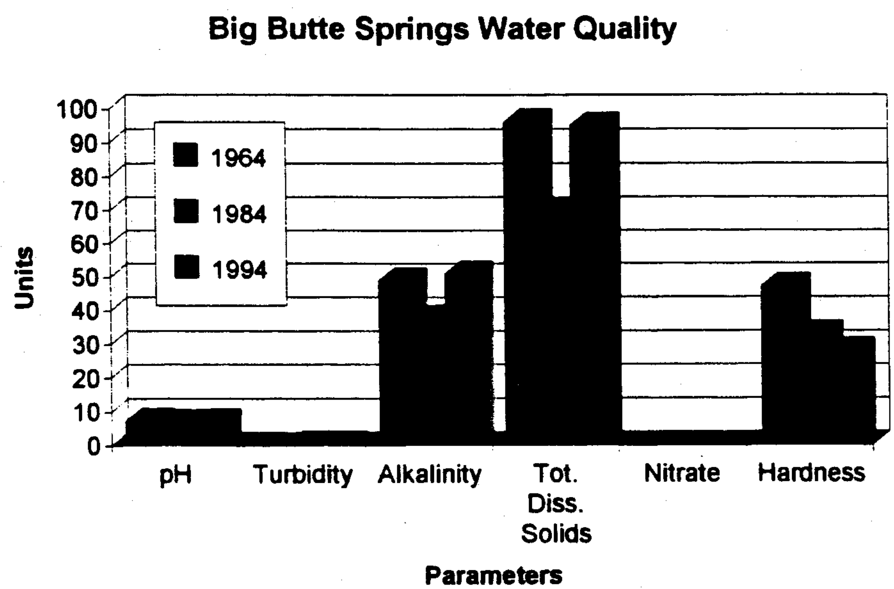
Fourbit Creek

1994 Temperature Study



T35S, R4E, S20 - Butte Falls RD, Rogue River NF

Figure H 7


Big Butte Springs Water Quality
Units
100
90
80
70
60
50
40
30
20
10
0
1964
1984
1994
pH
Turbidity
Alkalinity
Tot. Diss. Solids
Nitrate
Hardness
Parameters

H

APPENDIX B

INSECT AND DISEASE

BIG BUTTE WATERSHED
INSECT AND DISEASE CONDITIONS

Insects and pathogens are active in the Upper Big Butte Watershed. Along with fire and harvest, insect and diseases are responsible for large and small-scale disturbances distributed across the landscape. Insects and diseases are having a profound influence on vegetative structure, stocking, and species composition over various spatial and temporal scales. The magnitude of insect and disease disturbance is greatly influenced by stand species composition, age class, and history of other disturbances.

Insect and disease activity has increased since the turn of the century as a result of fire exclusion, introduction of exotic organisms, and management activities. In historic times, periodic fires kept stocking levels low to moderate. Dwarf mistletoe infection levels were relatively low because ground fires destroyed both infected understories and heavily infected overstory trees with large brooms close to the ground. Shade tolerant trees, generally more susceptible to root diseases and stem decays than seral species, were also limited by frequent fires.

Over large areas within the watershed, stocking levels are excessive in the understory, a direct result of effective fire suppression and past selective harvesting. Increased stocking has triggered bark beetle mortality, particularly in larger overstory pines. Douglas-fir dwarf mistletoe is abundant. Larger overstory trees are severely infected and understory Douglas-fir growing beneath infected overstories are infected or at high risk. In many areas, shade tolerant species are abundant. Root disease centers are maintained by this steady influx of susceptible species and are most likely larger in area than would have occurred during frequent fire regimes. Selective harvesting has increased root disease inoculum levels by creating cut-stumps and open wounds on residual trees, both of which act as infection courts. It also increases the food base available to some root disease-causing fungi. Increased wounding levels in residual trees also favors high rates of colonization by stem decay fungi. The introduction of white pine blister rust to the west coast in 1910 has led to substantial decline and mortality in the 5-needle pines, a species group that is considered relatively resistant to other agents.

Root Diseases and Associated Bark Beetles:

Root diseases are widely distributed throughout the Upper Big Butte Watershed. Severity varies with location; in many areas mortality is severe. The three main root diseases occurring are laminated root rot, caused by <u>Phellinus weirii</u>, Armillaria root disease, caused by <u>Armillaria ostoyae</u>, and annosus root disease, caused by the "S" strain of <u>Heterobasidion annosum</u>. All are considered diseases of the site; inoculum may remain viable in the wood of infected roots for 20 to 50 years. Their spread rates are slow, averaging 1-2 feet per year. Effects include growth loss, butt rot, predisposition to bark beetle attack, and mortality. Root diseases tend to be overlooked because of the subtle nature of their impacts, however over the long term, their effect on growth and survival is much larger than that of virtually any other agents.

In the Watershed Analysis Area, laminated root rot is usually found in small pockets (usually less than 1 acre in size) where Douglas-fir and grand fir in all size classes are killed. In a survey conducted in 1984 by Forest Pest Management, 17% of the 600-acre Umpire Thin Analysis Area was estimated to be in laminated root rot pockets, most of which were large in size (greater than 10 acres). Individual tree vigor does not influence infection by *P. weirii*; where susceptible host roots come into contact with viable inoculum, infection will take place. Small trees die standing. They are quickly killed and do not have enough crown mass to cause them to be windthrown. Larger trees may fall over, their rotted root systems evident, or they may die standing as a result of bark beetles that preferentially infest weakened trees. Conifers vary greatly in their relative susceptibility to *P. weirii*. In the Watershed, Douglas-fir and white fir are highly susceptible and are readily infected and killed. Shasta red fir and western hemlock are often infected but rarely killed. The pines and incense cedar are considered tolerant; they are seldom infected and almost never killed. All hardwoods are immune. Root disease-created openings are eventually colonized by less susceptible conifers, which maintain the fungus on the site, or by hardwood trees and shrubs which allow the slow disintegration of infected conifer root systems. Large, standing dead trees exist on the perimeters of pockets, however their unstable root systems cause them to fall over more quickly than snags resulting from other agents. Therefore, recruitment of down woody material is high on the perimeters of laminated root rot pockets. Future recruitment of large dead woody material (standing or down) inside centers is unlikely unless resistant or immune species become established on the site. Susceptible species will not attain large sizes within root disease pockets.

Armillaria root disease is commonly found in stands throughout the Big Butte Watershed where it occurs in large pockets (often greater than 1 acre in size). Its primary impacts are tree mortality and predisposition to bark beetle attack. Trees killed by Armillaria root disease tend to remain standing. All conifers are hosts to this pathogen. In most of the Watershed, white fir, Shasta red fir and Douglas-fir are highly susceptible and discrete pockets of mortality often result. In some locations, other species, such as sugar pine, western white pine, ponderosa pine and incense cedar, are readily killed. Armillaria root disease is usually associated with trees under stress or where man-caused disturbance is evident. Stumps created after logging can become colonized by this fungus, becoming effective food bases from which the fungus colonizes living trees. Soil compaction from ground-based equipment can also exacerbate existing conditions. Off-site plantings are particularly vulnerable to infection and mortality. Within the Watershed, off-site ponderosa pine plantings have very high mortality levels due to Armillaria root disease.

The role of annosus root disease in the Watershed is unclear. The fungus is present in large white fir and Shasta red fir scattered across the Watershed. Damage is usually in the form of butt rot. Fruiting bodies of the fungus are also present in white fir stumps, resulting from infections via wounds when trees were living as well as stump infections after tree harvest. Tree mortality from annosus root disease alone is rare. Occasionally small understory firs in close proximity to infected stumps are found infected. In other parts of the Region, it takes 10-15 years after true firs are harvested before the effects of annosus root disease are readily observed and levels of infection and mortality are much greater when true fir stands are entered more than once. It may be that annosus root disease on the Upper Big Butte has not developed sufficiently for large tree mortality to occur.

Bark beetles such as Douglas-fir beetle, Dendroctonus pseudotsugae and the Fir engraver beetle, Scolytus ventralis, are commonly associated with root diseases. The beetles are attracted to weakened trees. They maintain their endemic populations by attacking root disease-weakened trees inside and on the perimeters of root disease centers. In the case of Douglas-fir beetle, they can successfully breed in large down trees. Build up in beetle populations results when trees are also stressed by environmental conditions or when large scale windthrow events occur.

Pine Bark Beetles:

Mountain pine beetle, Dendroctonus ponderosae, and Western pine beetle, Dendroctonus brevicomis, attack trees that are stressed by root disease. However, infestation is more strongly correlated with low host vigor resulting from overstocking. In the Watershed, western pine beetle is found infesting ponderosa pine and mountain pine beetle is found attacking all pine species including ponderosa, lodgepole, western white, and sugar pines. Larger individual trees (greater than 8" diameter) are attacked. The beetles will also kill trees in small pockets. Stand basal areas greater than 120 square feet per acre are high risk for pines growing on moderate sites. High sites can maintain slightly higher basal area accumulations before they are at risk for bark beetle infestations. Competition among trees and shrubs of all species, not just the pines, contributes to pine susceptibility.

Bark beetles are currently active throughout the Watershed in stands with a pine component. Many stands are at high risk due to heavy stocking levels resulting from fire suppression. Mortality appears to be accelerating. Bark beetles will continue to kill the dominant and codominant ponderosa, western white and sugar pines within these stands unless stocking levels are controlled.

White Pine Blister Rust:

Since its introduction to the west coast of the United States, white pine blister rust, caused by the fungus Cronartium ribicola, has been responsible for mortality of 5-needle pines throughout their range. In the Upper Big Butte Watershed Analysis Area, white pine blister rust attacks sugar pine and western white pine. The fungus causes topkill and tree mortality and predisposes trees to attack by bark beetles. Environmental conditions for spore survival and infection are good, and adequate populations of the alternate hosts, Ribes spp. exist in the Upper Big Butte Watershed. White pine blister rust infections are common and threaten the long term survival of wild type white and sugar pines in these stands.

Dwarf Mistletoes:

Dwarf mistletoes, Arceuthobium spp. are parasitic plants that infect conifer species. Results from infection include growth loss, topkill, distortion, mortality, and predisposition to infection and attack by other agents such as Armillaria ostoyae and various bark beetles. Seeds are projected from plants and land on and infect susceptible hosts. Infection is favored by multi-layered canopies. Damage is greatest when the growing tops of trees are infected. Douglas-fir dwarf mistletoe is common and severe across the watershed. Heavily infected overstory trees have been killed outright by the dwarf mistletoe. Understory trees are also infected where they are growing under infected overstories. Height growth and vigor of these infected understory trees is being severely hampered by the presence of the pathogen. Other dwarf mistletoe species are present. True fir dwarf mistletoe, and its associated canker fungus Cytospora abietis, are contributing to the decline of white fir in some locations.

Stem Decays:

Phellinus pini, the cause of red ring rot is commonly found in mature and overmature Douglas-fir, Shasta red fir, white fir, ponderosa pine, sugar pine, and western white pine in the Watershed. It causes a severe stem decay and is responsible for considerable cull and breakage. Echinodontium tinctorium, the "Indian Paint Fungus", causes a rusty red stringy rot of grand fir and western hemlock. Mature and overmature trees are severly culled and often break. Suppressed understory trees residing below infected overstories are often infected. The infections will remain dormant until they are activated by wounding. These heart rots provide excellent conditions for excavation by cavity nesting birds.

Summary

Insects and diseases are responsible for large and small scale changes in vegetative composition, stocking, and structure in stands of the Upper Big Butte Watershed. Their activities are expected to continue and increase due to heavy stocking, past harvest activity, multi-layered canopies, and higher proportions of species prone to root diseases and stem decays resulting from fire exclusion.

The staff of the Southwest Oregon Forest Insect and Disease Technical Center is willing to provide further assistance to those responsible for the Upper Big Butte Watershed Analysis. Please feel free to call us at 858-6125.

Ellen Michaels Goheen
Plant Pathologist
June, 1995

APPENDIX C

RARE PLANTS

RARE PLANTS IN BIG BUTTE WATERSHED ANALYSIS AREA

There are 6 sensitive plant species known to be located in the Big Butte Watershed Analysis Area: Howell's false-caraway (*Perideridia howellii*), Pigmy monkeyflower (*Mimulus pygmaeus*), Clustered lady's slipper (*Cypripedium fasciculatum*), Green-flowered ginger (*Asarum wagneri*), Mt.Mazama collomia (*Collomia mazama*), and Detling's microseris (*Microseris laciniata* ssp. *detlingii*). Other species of concern are: Mountain lady's slipper (*Cyripedium montanum*), and ground rose (*Rosa spithamea* var. *spithamea*.

Howell's false-caraway is associated with riparian areas near Ash Swale, Juniper Ridge, Willow Lake, and Butte Falls/Fish Lake Highway. There are 5 main populations of this species in the Big Butte Analysis Area.

Pigmy monkeyflower is only known from one location in the Big Butte Analysis Area or on the Butte Falls Ranger District. One other population is located west of the town of Butte Falls. The habitat of this small annual is vernally wet areas. Population size varies from year to year and seems to be more abundant in wetter years. According to the Oregon Natural Heritage Program, August, 1993 it is known from Douglas, Hood, Jackson, Josephine, Klamath, Lane, and Linn counties.

One population of Clustered lady's-slipper is located on private land in the Big Butte Analysis Area near Willow Lake. This orchid perfers closed-canopy coniferous forest or forest with filtered sunlight usually when hardwoods are present. It is known from small scattered populations in Oregon, Idaho, Washington, California, and Utah.

Mt. Mazama's Collomia is an endemic species found only from Douglas, Jackson, and Klamath Counties. Most of the populations are located on the Prospect and Butte Falls Ranger Districts. The populations are often large and contiguous in forest with filtered sunlight, open dry places at forest edge, or open dry places. It's habitat is usually associated with Shasta red fir, western hemlock, and white fir at high elevations. In Prospect it is often located in moist meadow situations.

Another endemic sensitive species is the green-flowered wild ginger. In the Big Butte Analysis Area the habitat is similar to the habitat Mt. Mazama's Collomia and shares with the exception of located near Whiskey Springs and Rye Springs. It is also located in Douglas, Jackson, and Klamath counties. Habitats differ with populations. It is found at high elevations, usually in lava flows, however, it is also found at lower elevations in earlier succession pine forests. This species seems to prefer the edge effect with some shade. Monitoring of test plots and genetic testing that is under way will help to determine if this species increases or decreases as the canopy closes.

Detling's microseris is a member of the sunflower family that is located near highway 140. This population was located several years ago and has not been found since. It is known only from Jackson county. It's habitat is open grasslands and meadows and forest edge.

Mountain lady's-slipper is listed in Region 6 as a watch list species, and a strategy 1 survey and manage species in the Record of Decision (ROD). It is a species of concern and very important for local biodiversity. Although it is abundant and relatively stable in the Blue Mountains of Oregon, it is found only in scattered locations in the Cascades and Siskiyou Mountains. It grows mainly in closed canopy or forest with filtered sunlight. Some populations are in openings but it's viability in this situation is being studied. The ROD recommends that all known populations be protected. Two populations are known in the Big Butte Analysis Area.

Only areas that have been proposed for habitat modification have had surveys in the past. There still are still areas that have not been surveyed for plants of concern. Some plants are found only in certain times the year or may not be present every year depending on climatic and other conditions. The list of species that are surveyed for may change from year to year as new information is gathered. Past surveys should always be reviewed prior to any additional ground disturbance to ensure that the current list of possible rare plants have been looked for in the survey.

Carol Harmount, Botanist

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APPENDIX D

WILDLIFE AND RANGE

Big Butte Watershed

WILDLIFE & RANGE REPORT

FINAL

U.S. FOREST SERVICE
BUTTE FALLS RANGER DISTRICT
ROGUE RIVER NATIONAL FOREST
SCOTT G. ARMENTROUT
DISTRICT BIOLOGIST

INTRODUCTION

The Big Butte Springs Watershed (BBWA) lies within the Western Cascades physiographic province. The watershed has a long history of human influence, beginning several thousand years ago with native American cultures. The advent of European settlement, most pronounced beginning in the 1870's, began a period of rapid changes in wildlife habitat and species composition. Stands of timber were cut to allow crops to be grown and livestock to graze, large predators were hunted or trapped and sawmills began operations in the area to supply the growing Rogue Valley with supplies of lumber.

The geography of the BBWA encouraged early settlers to focus attention on the area for material needs. The topography is relatively flat, with few major geographic obstacles between the watershed and the Rogue Valley. Materials and supplies were easily transported to the area from railroad lines in the valley. The large areas of old-growth forest, and the ease of accessibility, promoted the construction of railroad lines directly into the watershed.

In addition to timber resources, the area also has abundant water in the form of springs. The largest of these is Big Butte Springs, which produces 26 million gallons of water per day. This water was quickly recognized as a valuable commodity to the farmers and orchardists in the Rogue Valley, who diverted the springs to water their crops. These springs were later dedicated to municipal use as populations in the Rogue Valley increased. Today, Big Butte Springs supplies water to the city of Medford and surrounding areas.

The clearing of land, extraction of old-growth timber and diversion of water combined with interdependent and inter-related activities such as road building, home construction, and a myriad of others, has had a dramatic affect on the wildlife of the watershed. Wildlife populations and habitat composition in 1995 are far removed from what existed when European settlement began in earnest in the mid 1800's. The ecosystem has been changed to such an extent, that return to "natural" conditions is not possible.

BIG BUTTE SPRINGS - 1887 to Present

Historical information regarding wildlife populations prior to 1900 is limited to accounts from the journals of early settlers. Levi Harper Mattox was a school teacher in 1887 and 1888 at a school near present day Ash Swale within the Big Butte Springs watershed. His journal contains descriptions of the wildlife and habitat in the area. Mattox describes the presence of many species which have been extirpated from the watershed. These include gray wolves, grizzly bear and lynx. The forest is described as being almost "completely untouched" with large sugar pines and Douglas fir evident throughout the area. The only openings described in the forest at that time were small pieces of farmland cleared for growing wheat and a large marshy wetland at Ash Swale. The presence of fire is also noted, with Mattox describing the smoky conditions throughout the area in the summer.

Wildlife was a valuable commodity to the early residents of the watershed. Deer were a primary source of food during Mattox's tenure at the school. He makes reference to attempts to

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start up a "venison cannery", which would supply meat to the valley. Of particular note is that nowhere in the journal is the presence of elk noted. The deer herds were hunted year round. Trapping was another primary occupation in the area. Furbearers, including lynx, were trapped for their fur. Mattox describes one incident in which two lynx were captured on a trap line. Wolves and grizzly bears were killed on sight in the 1870s. Several incidents of wolves and grizzlies being killed are noted.

The primary value of this account is the description of the extirpated species. Grizzly bears, wolves and lynx all occupy top positions in food chains. The loss of these species from the food chain changes the processes and composition of the ecosystem. The "untouched" nature of the forest lands in 1887 are vastly different than today's condition. Approximately 5 percent of the watershed contains old-growth forest today.

The construction of railroads into the watershed during the 1920s began a period of major changes to the forests in the watershed. Logging camps were created throughout the area. Large scale timber harvest occurred, especially targeting large sugar pine, ponderosa pine and Douglas fir. Saw mills were in operation in the Butte Falls area as well as the Rogue Valley. In addition to the harvest, forest fires were controlled with a great deal of success. The normal progression of fires throughout the area was changed, altering yet another portion of the ecosystem on the watershed.

In the 1930s, the Civilian Conservation Corps (CCC) began a series of re-forestation projects in the area. They planted several sites with non-local species. These plantations of "off-site" pine and fir introduced new gene pools to the local ecosystem. In order to insure the success of these plantations, strychnine baiting stations were established to control porcupine and squirrel populations. These sites were composed of a platform which covered strychnine laced corn or other grains, and a fence to keep deer out of the area. Stations such as these were in use up to the 1970s, and probably had major impacts on a variety of species. The remains of these stations can still be found within the watershed. Seed eating birds were quite possibly killed in large numbers, along with secondary impacts to species which preyed upon the birds. Small mammals and mustelid species such as wolverine, fisher and marten were almost certainly severely impacted by this process as well.

Road building began in earnest during the 1960s. Roads were built to access stands of timber for harvest and recreational use. The entire Big Butte Watershed is heavily roaded today, averaging 3 miles of road per square mile. Roading provided corridors for exotic species to migrate into the area and contributes to habitat fragmentation.

Another forest management practice which impacted the ecosystem was the spraying of herbicides and pesticides such as DDT. DDT has been shown to enter the food chain at the lowest level, progressing upwards to the top. It is likely that DDT was used in the area, and that it had impacts to raptors such as peregrine falcons and goshawks. The variety of herbicides used is not known, but many of these were undoubtedly introduced into the food chain of the watershed, producing many undocumented effects to species.

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The designation of Big Butte Springs as a municipal watershed impacted wildlife in the area. Concern over contamination by giardia led to wholesale trapping of beaver populations. The intent of the trapping was to eliminate beaver populations from the watershed. Historical beaver trapping occurred as well, therefore the prevention trapping was practiced upon an already reduced population. Documentation on file at the Butte Falls Ranger Station indicates that beavers were almost entirely eliminated from the area. Beaver populations are now beginning to re-bound, but the loss of wetland habitat from beaver trapping continues to impact the watershed.

Willow Lake reservoir was created by the City of Medford to replace irrigation rights from Big Butte Springs with rights to reservoir water. The creation of this impoundment inundated a large area and created a habitat type not present earlier. The reservoir provides habitat to species of wildlife not previously utilizing the area. These include waterfowl, bald eagles and shore birds.

Wildlife management throughout this period focused primarily on big game and predator management. Elk were re-introduced to Crater Lake National Park, eventually populating the entire province. Elk, not present in the 1870's, now have almost reached carrying capacity within the watershed. Cougar populations were hunted to very low levels until the State designated them as a game species. Since that time, cougar populations are thought to be "healthy" and increasing. Black bear were hunted as a game animal, but little is known about the status of this species. It is assumed that black bear populations are at least stable. Blacktail deer and elk are hunted each year by large numbers of people. Hunting has been the primary source of predation on these populations since wolves and grizzly bears were eliminated. Recently, turkeys have been introduced to the watershed by the Oregon Dept. of Fish and wildlife. The affects of this introduction to the native ecosystem are not yet clear.

Cattle grazing is another factor influencing the ecosystem. Cattle and/or sheep have been grazed in large numbers since the early 1900's. These animals have no counterpart in the native species of the area. An inter-related affect of cattle and sheep grazing includes the introduction of European and Asian grass and forb species to enhance forage production. Native meadow and forest vegetation is often dominated by these exotic invaders, replacing native ecosystems with foreign processes.

CURRENT CONDITION

Threatened, Endangered and Sensitive Species (T,E,S)

No endangered species are known to currently reside on the Big Butte Springs watershed. Peregrine falcons may utilize the area for foraging, but no documented sightings exist. Threatened species include the northern spotted owl and bald eagle. One bald eagle site exists at Willow Lake reservoir. The nest tree is actually on lands owned by the Medford Water Commission, but the nesting territory contains National Forest land. This site successfully produced one juvenile in 1994, and it appears that the site is has good habitat and foraging area. Several spotted owl pairs and singles are found in the watershed. Further information about this

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site can be found in the Willow Lake Bald Eagle Management Area Plan on file at the Butte Falls Ranger District.

Intensive spotted owl surveys have been conducted since 1989. 7 spotted owl pairs have been located. All 7 pairs' home ranges exceed "take" thresholds set by the U.S. Fish and Wildlife Service. Take thresholds are greater than 40% suitable habitat within a 1.2 mile radius and/or 500 acres within 0.7 miles. Sites exceeding this guideline are deemed non-viable for the purpose of this document. The poor habitat situation of these sites indicates that spotted owls within the watershed are at high risk. No viable home ranges currently exist, therefore the spotted owl may be extirpated as a nesting species from the BBWA.

The watershed lies between two late successional reserves (LSRs) established by the *Record of Decision for amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (RO226 and RO227). LSR 227 is a critical link between the Western Cascades and Klamath Mountain provinces. It is essential that dispersal habitat is adequate to maintain this important link. R0226 is the primary source for dispersal to R0227 from the Cascades. Big Butte Watershed occupies a large portion of the lands between the LSRs. The importance of adequate dispersal habitat in the watershed is very important because of the lack of viable owl pairs outside of LSRs. Almost no dispersal has been documented between the two LSRs, indicating that dispersal habitat may be a limiting factor for the owl population in this area. Of the 12 quarter townships occupied by the watershed, 3 are below recommended levels of dispersal habitat. Recommended dispersal habitat consists of 50% of the area with at least 40 percent canopy closure and stands of timber greater than 11 inches dbh.

Gray wolves and Grizzly bears, both on the Federal endangered list, are considered extirpated from the state of Oregon. As identified earlier, these species once were common with the BBWA.

Regional Forester's Sensitive Species List

Several wildlife species from the regional forester's sensitive species list are known to occur within the BBWA. They are: California wolverine (*Gulo gulo luteus*), northwestern pond turtle (*Clemmys marmorata*), greater sandhill crane (*Grus canadensis tabida*) and pacific western big-eared bats (*Plecotus townsendi townsedi*). Red legged frogs (*Rana aurora*), white footed voles (*Arborimus albipes*), Siskiyou Mountain salamanders (*Plethodon stormii*) and ferruginous hawks (*Buteo regalis*), are potentially found on the Rogue River National Forest, but the presence of these species has never been documented and there is no indication that these species have ever been present on the BBWA.

California wolverine: Several California wolverine sightings have occurred within the BBWA. The most recent sightings were in the Juniper Ridge area of the watershed in 1994. Surveys have been conducted for wolverines using baited remote camera stations. No wolverines have been detected. The wolverine is a solitary and secretive animal with a large range. It is assumed that the wolverine population in southern Oregon is at very low

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levels. Additional surveys will be needed to verify the extent of this species in the watershed. Historical population levels in the BBWA were probably always low due to the large home range of the wolverine, but it can be assumed that overall population levels in the province were much higher prior to the advent of European settlement.

Northwestern Pond Turtle: Pond turtles are common in the BBWA. Sightings of pond turtles are documented in Ash Swale, Willow Lake, Bowen creek pond, Skeeter swamp and several pumper fill stations. The overall population size is not known. Reproductive success is also an unknown. Additional surveys are needed to determine the health and viability of this species. Historical population levels may have been lower than what exists today. The creation of ponds, pumper fills and Willow lake has increased suitable habitat for the pond turtle. The major limiting factor for this species is possibly breeding habitat, due to the high road densities and cattle/elk grazing.

Greater Sandhill Cranes: Cranes have been documented at Willow Prairie, Ash Swale, Whiskey Springs and Skeeter swamp. They are also common on private lands within the watershed boundary. Reproductive success of sandhill cranes in the area is limited. The only successful reproduction documented occurred in 1993 at Whiskey Springs. A single young was fledged. The fledgling was later killed by a dog abandoned at Whiskey Springs campground. This species may be more common on the BBWA at present than in historical times. Meadows and open areas are preferred foraging habitat. Many meadows have been created in order to provide forage for livestock. Early records indicate only limited meadow habitat existed historically. The reproductive viability of cranes nesting in the area is questionable due to the grazing, roading and recreational activities in the area. Additional surveys are needed to assess habitat usage by cranes in the area. Habitat should be enhanced in suitable breeding areas.

Pacific Western Big-Eared Bat: Big eared bats are suspected to utilize portions of the BBWA for foraging areas. A maternal roost site is located near the town of Butte Falls, and the bats range extends into the watershed area. No known caves or roosting habitat that can sustain these bats exist on the BBWA. Populations of foraging bats are suspected to be smaller than historic levels due to human impacts at roosting and maternal sites.

Survey and Manage Species (ROD)

Fringed Myotis (*Myotis thysanodes*)
Silver-haired bat (*Lasionycteris noctivagans*)
Long-eared myotis (*Myotis Evotis*)
Long-legged myotis (*Myotis volans*)
Pallid Bat (*Antrozous pallidus*)

Red Tree vole(*Phenacomys longicaudus*)

Great Gray Owl (Strix nebulosa)
Pygmy Nuthatch (Sitta pygmaea)

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Very little is known about the status of survey and manage bat species on the BBWA. Surveys by Cross (1976) and District personnel in 1993-95 have verified the presence of all but pallid bats. Cross identified fringed myotis in 1976 but attempts to survey the same sites in 1994 resulted in no captures of this species. The lack of large snags throughout the BBWA probably limits the population of pallid bats and fringed myotis. No details of these populations can be discussed without adequate surveys of populations and habitat use.

Red tree voles have not been documented on the BBWA, but no surveys have been conducted to establish presence. When a survey protocol is developed for this species, surveys need to be conducted to determine the status of this species on the BBWA.

Great Gray owls have been documented throughout the BBWA. Nesting sites have been located in the Willow Prairie area. Most great gray sightings were documented during surveys for Northern spotted owls. Great gray owls appear to be using harvest units as foraging area as well as natural meadows. No great gray specific surveys have been conducted. Artificial nest platforms have been erected in the Willow Prairie area and in several timber sale areas. No documented nesting has occurred on these platforms, but additional monitoring is necessary to determine the success of these structures. Surveys adhering to great gray owl protocol need to be conducted to make any accurate analysis of population size or habitat use.

Pygmy nuthatches have not been documented on the BBWA. Additional surveys are necessary before an assessment can be made.

Blacktail Deer and Roosevelt Elk

The BBWA has a healthy blacktail deer population according to the Oregon Department of Fish and Wildlife (ODFW). The population on the watershed is migratory, with the majority of the area providing summer range. The ODFW is currently conducting a study of the survival rate of blacktail deer as well as their migratory patterns. When this study is complete, a more complete analysis of the status of this species can be made. Deer are hunted in the fall throughout the watershed. Deer hunting is one of the primary recreational activities that occur in the area. Historically, deer populations were regulated by the presence of predators such as wolves and grizzly bears. The extirpation of these species has seen sport hunting replace their role in the ecosystem.

Roosevelt elk herds continue to expand throughout the BBWA. Populations have been growing at a consistent rate according to the ODFW. Habitat for elk in the BBWA is at optimum levels for elk. The majority of the area is summer range, and there is an abundance of forage intermixed with hiding and thermal cover. A suitable range analysis was conducted on the Fish Lake allotment, which occupies the southern half of the watershed. This analysis determined that 7376 acres produce more than 100 pounds of grass forage per acre (dry weight). The Rancheria allotment, which has no survey information, should have even more

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forage areas than this. The range analysis does very little browse rating, which is a primary component of the elk's diet. Observations of the area indicate that an abundance of browse exists. ODFW estimates that the population of elk in the area will continue to increase. Sport hunting is the primary source of predation on the elk herd. Harvests have been consistently increasing in the area, with more and larger bulls killed each year.

Elk and deer herds should continue to maintain good habitat conditions in the BBWA. The matrix classification of most of the area will allow continued creation of foraging areas. Riparian corridors will provide migration routes as well as thermal cover. Road density within the area is 3.1 miles of road per square mile. Elk use of habitat is dramatically and adversely affected by roads open to vehicular traffic (Wisdom et al 1986). The level of roading in the watershed eliminates habitat effectiveness by approximately 50% when compared to the habitat effectiveness index model developed by Wisdom et al (1986). Road closures due to the municipal watershed mitigate this problem. Roads closed to vehicular traffic do not result in significant disturbance of deer and elk and often are used for foraging, bedding and travel. Roads within the BBWA that are not necessary for year-round access should be closed with gates or berms. New roads should be gated or bermed as soon as possible after use. As brush and early successional timber stands continue to mature, opportunities to create and enhance forage should be considered.

Other Species Considerations

Pacific Fisher and American marten are two mustelid species inhabiting the BBWA. Surveys for fisher and marten in 1992-95 have detected the presence of marten in the area. No fisher sightings have been documented on the watershed but presence was detected on the boundary. Surveys have been limited in the area. Additional surveys will be needed to establish population levels, habitat use and species status in the area.

Northern goshawk sightings in the area are very limited in comparison to South Fork Rogue River and Middle Fork watersheds. The shift in habitat over time may contribute to the lack of goshawks in the area. No surveys have been conducted for goshawks in the watershed. Surveys would be needed to determine the status of this species in the area.

Neotropical bird species nest throughout the watershed. A monitoring avian productivity and survival station (MAPS) has been established in the Skeeter Swamp area of the BBWA. Data from these station will provide information on the types of species and survival rates on the watershed. The MAPS station should be operated for at least 5 years to obtain useful data from the site. MAPS stations provide baseline information on population sizes and species composition in an area. They also provide range wide information if the are operated for a sufficient length of time.

Knowledge of amphibian and reptile species and their status is limited. No surveys of any type have been conducted on the area. Surveys are necessary before adequate discussion of these species can be attempted.

LIVESTOCK USE OF THE BBWA

Livestock have been present in the area since the 1870s. Range analysis has shown that large amounts of suitable rangeland exists in the area. No impacts to water quality have been documented as a result of livestock in the area. Allotment management plan updates need to be completed for the area as soon as possible. These updates will set carrying capacities to insure proper numbers are grazed. The livestock grazing in the area has had no documented negative impacts to wildlife in the area.

CONCLUSION AND RECOMMENDATIONS

The current condition of the BBWA does not resemble the historical descriptions of the area at the advent of European settlement in the 1870s. The vegetative characteristics have changed considerably due to timber harvest, fire control, ranching, farming and roading. The overall impacts of these changes are not known due to a lack of information on the current status of most species found on the watershed.

General analysis of the status of wildlife within the watershed can be made based on the condition of habitat as it exists at present and region-wide. Wildlife species have undergone a dramatic shift. Extirpations of gray wolves, grizzly bears and possibly wolverine indicate that predator species historically present in large numbers have been eliminated. These species will probably never return to the area due to habitat fragmentation and political considerations.

Northern spotted owl populations have probably been steadily decreasing since the 4-Bit Ford timber sale. Historical habitat conditions prior to the 4-Bit sale indicate that the majority of the area was composed of old-growth ponderosa pine stands with open understory. Owl populations in the area may never have been high. The primary concern for owl populations is dispersal habitat. Harvest prescriptions in the area need to stress maintenance of this important habitat component.

Overall, most species that were historically present in the area occupy the BBWA today. The status of these species and their importance at the province level, is generally not known due to the absence of any data on population sizes or habitat usage. The establishment of riparian reserves in the BBWA by the ROD will probably insure that most species in the area continue to maintain a stable presence locally. It is important that riparian buffer zones be maintained at the two tree height level for fish bearing streams and the one tree height level for non-fish bearing streams to maintain these important "arteries" of the ecosystem. The establishment of buffer zones for northern spotted owls (100 acres) and great gray owls (1/4 mile for nest sites, 300 feet for all meadows) will add additional refugia areas to maintain local populations of wildlife. All projects must be adequately surveyed prior to implementation to insure that these buffer zones are established as directed by the ROD.

Current numbers of livestock being grazed in the BBWA appear to be at or near projected carrying capacities on the Fish Lake allotment. No updated analysis has been done on the Rancheria allotment but it is estimated that numbers there are below carrying capacities.

Future monitoring will be necessary to accurately portray the conditions of wildlife species inhabiting the watershed. Priority monitoring should first consist of presence or absence studies, targeting species of concern first. Once presence or absence is established, larger scale monitoring efforts can be conducted to determine distribution, reproductive status and habitat use.

SUMMARY OF RECOMMENDATIONS

Recommendations made in previous sections of this document are summarized below:

➢Maintain dispersal habitat for northern spotted owls throughout the area. 50% of the area with at least 40% canopy closure and timber stands greater than 11 inches dbh.

➢Conduct presence absence studies for California wolverine.

➢Conduct presence absence and habitat use studies for northwestern pond turtles.

➢Monitor habitat use of sandhill cranes. Improve habitat in breeding areas.

➢Conduct surveys for survey and manage bat species. Follow up 1976 surveys.

➢Utilize protocol for red tree voles and survey for presence or absence

➢Survey all planned projects for great gray owls. Insure 1/4 mile protection buffers are established around all located nest sites. Insure 300 feet buffers are established on meadow areas.

➢Survey for presence or absence of pygmy nuthatches

➢Gate or berm new roads to mitigate degradation of Roosevelt elk and Blacktail deer habitat. Insure existing closures are maintained year round on the watershed.

➢Create forage for big game using prescribed fire, timber harvest and brush removal.

➢Continue surveys for fisher and marten. Expand PNW study to the Butte Falls District.

➢Survey for goshawks using standard protocols.

➢Continue to operate Skeeter Swamp MAPS station for at least 5 years.

➢Survey for presence or absence of amphibian and reptile species suspected of inhabiting the BBWA.

➢Update allotment management plans for the Fish Lake and Rancheria allotments.

➢Maintain ROD designated two tree height buffers on all fish bearing streams and one tree height buffers on non-fish bearing streams.

SUMMARY OF KEY QUESTIONS ADDRESSED BY THIS DOCUMENT

1. What wildlife species inhabit the watershed and what processes affect their welfare.

2. What wildlife species recognized as in peril (T,E,S) are present in the watershed and how does the watershed provide habitat for those species relative to their entire range.

Appendix

United States Department of the Interior

MAY 25 1995

FISH AND WILDLIFE SERVICE
Oregon State Office
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266
(503) 231-6179 FAX: (503) 231-6195

May 15, 1995

In reply refer to: 1-7-95-SP-265

James Gladen
Rogue River National Forest
PO Box 520
Medford, OR 07501

Dear Mr. Gladen:

This is in response to your letter, dated 6 April 1995, requesting information on listed and proposed endangered and threatened species that may be present within the area of the Rogue River National Forest in Oregon. The U.S. Fish and Wildlife Service (Service) received your letter on 12 April 1995.

We have attached a list (Attachment A) of threatened and endangered species that may occur within the area of the Rogue River National Forest. The list fulfills the requirement of the Service under section 7© of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). Forest Service (FS) requirements under the Act are outlined in Attachment B.

The purpose of the Act is to provide a means whereby threatened and endangered species and their ecosystems on which they depend may be conserved. Under section 7(a)(1) and 7(a)(2) of the Act and pursuant to 50 CFR 402 *et seq.*, FS is required to utilize their authorities to carry out programs which further species conservation and to determine whether projects may affect threatened and endangered species, and/or critical habitat. A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) which are major Federal actions significantly affecting the quality of the human environment as defined in NEPA (42 U.S.C. 4332 (2)(c)). For projects other than major construction activities, the Service suggests that a biological evaluation similar to the Biological Assessment be prepared to determine whether they may affect listed and proposed species. Recommended contents of a Biological Assessment are described in Attachment B, as well as 50 CFR 401.12.

If FS determines, based on the Biological Assessment or evaluation, that threatened and endangered species and/or critical habitat may be affected by the project, FS is required to consult with the Service following the requirements of 50 CFR 402 which implement the Act.

ROGUE RIVER N.F.
MAY 22 1995
Supv.
Dep. Supv.
Scty
PAO
Recep.
LMP
TM
TAM
R. WL WS
Rec/Lnd/M
Fire
MFC
Eng
AO
MIS
Auto Shop
Dist.

Attachment A includes a list of candidate species under review for listing. These candidate species have no protection under the Act but are included for consideration as it is possible candidates could be listed prior to project completion. Thus, if a proposed project may affect candidate species, FS is not required to perform a Biological Assessment or evaluation or consult with the Service. However, the Service recommends addressing potential impacts to candidate species in order to prevent future conflicts. Therefore, if early evaluation of the project indicates that it is likely to adversely impact a candidate species, FS may wish to request technical assistance from this office.

Your interest in endangered species is appreciated. The Service encourages FS to investigate opportunities for incorporating conservation of threatened and endangered species into project planning processes as a means of complying with the Act. If you have questions regarding your responsibilities under the Act, please contact Joe Burns at (503) 231-6179. All correspondence should include the above referenced case number.

Sincerely,

Gary S. Miller

for Russell D. Peterson
State Supervisor

Attachments
SP 265
cc: PFO-ES
ODFW (nongame)

ATTACHMENT A

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE ROGUE RIVER NATIONAL FOREST
1-7-95-SP-265

LISTED SPECIES[1,2/]

Birds		
Peregrine falcon	*Falco peregrinus*	LE
Documented Rogue River NF		
Bald eagle	*Haliaeetus leucocephalus*	LT
Documented Rogue River NF		
Northern spotted owl	*Strix occidentalis caurina*	LT
Documented Rogue River NF		

PROPOSED SPECIES[/]

None

CANDIDATE SPECIES[3,4/]

Mammals		
White-footed vole	*Arborimus albipes*	C2
California wolverine	*Gulo gulo luteus*	C2
Documented Rogue River NF		
Pacific fisher	*Martes pennanti pacifica*	C2
Documented Rogue River NF		
Long-eared myotis (bat)	*Myotis evotis*	C2
Fringed myotis (bat)	*Myotis thysanodes*	C2
Long-legged myotis (bat)	*Myotis volans*	C2
Yuma myotis (bat)	*Myotis yumanensis*	C2
Pacific western big-eared bat	*Plecotus townsendii townsendii*	C2
Documented Rogue River NF		
Birds		
Northern goshawk	*Accipiter gentilis*	C2
Documented Rogue River NF		
Little willow flycatcher	*Empidonax traillii brewsteri*	C2
Amphibians and Reptiles		
Tailed frog	*Ascaphus truei*	C2
Documented Rogue River NF		
Northwestern pond turtle	*Clemmys marmorata marmorata*	C2
Documented Rogue River NF		
Del Norte salamander	*Plethodon elaongatus*	C2
Documented Rogue River NF		
Siskiyou Mountains salamander	*Plethodon stormi*	C2
Documented Rogue River NF		

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Northern red-legged frog	*Rana aurora aurora*	C2
Foothill yellow-legged frog	*Rana boylii*	C2
Documented Rogue River NF		
Cascades frog	*Rana cascadae*	C2
Documented Rogue River NF		
Spotted frog	*Rana pretiosa*	C2
Documented Rogue River NF		
Southern torrent salamander	*Rhyacotriton variegatus*	C2
<u>Fish</u>		
Pacific lamprey	*Lampetra tridentata*	C2
<u>Invertebrates</u>		
Denning's agapetus caddisfly	*Agapetus denningi*	C2
Documented Rogue River NF		
Siskiyou chloealtis grasshopper	*Chloaeltis aspasma*	C2
Documented Rogue River NF		
Siskiyou caddisfly	*Tinodes siskiyou*	C2
Documented Rogue River NF		
<u>Plants</u>		
Crater Lake rock cress	*Arabis suffrutescens* var. *horizontalis*	C2
Crenulate grape-fern	*Botrychium crenulatum*	C2
Pumice grape-fern	*Botrychium pumicola*	C2
Purple toothwort	*Cardamine gemmata*	C2
Tall bugbane	*Cimicifuga elata*	C2
Documented Rogue River NF		
Mount Mazama collomia	*Collomia mazama*	C2
Documented Rogue River NF		
Clustered lady's-slipper	*Cypripedium fasciculatum*	C2
Documented Rogue River NF		
Umpqua green-gentian	*Frasera umpquaensis*	C2
Documented Rogue River NF		
Elegant gentian	*Gentiana plurisetosa*	C2
Documented Rogue River NF		
Henderson's horkelia	*Horkelia hendersonii*	C2
Documented Rogue River NF		
Mt. Ashland lupine	*Lupinus aridus* ssp. *ashlandensis*	C1
Documented Rogue River NF		
Pygmy monkeyflower	*Mimulus pygmaeus*	C2
Documented Rogue River NF		
Red-root yampah	*Perideridia erythrorhiza*	C2
Coral-seeded allocarpa	*Plagiobothrys figuratus* var. *corallicarpus*	C2
Applegate stonecrop	*Sedum oblanceolatum*	C2
Documented Rogue River NF		
Columbia cress	*Rorippa columbiae*	C2
Howell's tauschia	*Tauschia howellii*	C2
Documented Rogue River NF		

(LE) - Listed Endangered | *(LT) - Listed Threatened* | *(CH) - Critical Habitat has been designated for this species*
(PE) - Proposed Endangered | *(PT) - Proposed Threatened* | *(PCH) - Critical Habitat has been proposed for this species*
(S) - Suspected | *(D) - Documented*

(C1)- Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(C2)- Category 2: Taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

(3A)- Category 3A: Taxa for which the Service has persuasive evidence of extinction.

(3B)- Category 3B: Names that on the basis of current taxonomic understanding do not represent taxa meeting the Act's definition of "species."

(3C)- Category 3C: Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.

* *If a vertebrate or plant, a single asterisk indicates taxon is possibly extinct. If an invertebrate, a single asterisk indicates a lack of information for the taxon since 1963.*

** *Consultation with National Marine Fisheries Service required.*

1/ *U. S. Department of Interior, Fish and Wildlife Service, August 23, 1993, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12.*

2/ *Federal Register Vol. 57, No. 10, January 15, 1992, Final Rule-Critical Habitat for the Northern Spotted Owl*

3/ *Federal Register Vol. 59, No. 219, November 15, 1994, Notice of Review-Animals*

4/ *Federal Register Vol. 58, No. 188, September 30, 1993, Notice of Review-Plants*

ATTACHMENT B

FEDERAL AGENCIES RESPONSIBILITIES UNDER SECTIONS 7(a) and (c) OF THE ENDANGERED SPECIES ACT

SECTION 7(a) - Consultation/Conference

Requires: 1) Federal agencies to utilize their authorities to carry out programs to conserve endangered and threatened species;

2) Consultation with FWS when a Federal action may affect a listed endangered or threatened species to insure that any action authorized, funded or carried out by a Federal agency is not likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of Critical Habitat. The process is initiated by the Federal agency after they have determined if their action may affect (adversely or beneficially) a listed species; and

3) Conference with FWS when a Federal action is likely to jeopardize the continued existence of a proposed species or result in destruction or adverse modification of proposed Critical Habitat.

SECTION 7(c) - Biological Assessment for Major Construction Projects 1/
Requires Federal agencies or their designees to prepare a Biological Assessment (BA) for construction projects only. The purpose of the BA is to identify any proposed and/or listed species which are/is likely to be affected by a construc- tion project. The process is initiated by a Federal agency in requesting a list of proposed and listed threatened and endangered species (list attached). The BA should be completed within 180 days after its initiation (or within such a time period as is mutually agreeable). If the BA is not initiated within 90 days of receipt of the species list, the accuracy of the species list should be informally verified with our Service. No irreversible commitment of resources is to be made during the BA process which would foreclose reasonable and prudent alternatives to protect endangered species. Planning, design, and administrative actions may be taken; however, no construction may begin.

To complete the BA, your agency or its designee should: (1) conduct an on- site inspection of the area to be affected by the proposal which may include a detailed survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or for potential reintroduction of the species; (2) review literature and scientific data to determine species distribution, habitat needs, and other biological requirements; (3) interview experts including those within FWS, National Marine Fisheries Service, State conservation departments, universities, and others who may have data not yet published in scientific literature; (4) review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat; (5) analyze alternative actions that may provide conservation measures and (6) prepare a report documenting the results, including a discussion of study methods used, any problems encountered, and other relevant information. The BA should conclude whether or not a listed or proposed species will be affected. Upon completion, the report should be forwarded to our Portland Office.

1/ A construction project (or other undertaking having similar physical impacts) which is a major Federal action significantly affecting the quality of the human environment as referred to in NEPA (42 U.S.C. 4332.(2)c). On projects other than construction, it is suggested that a biological evaluation similar to the biological assessment be undertaken to conserve species influenced by the Endangered Species Act.

MAMMALS:

Cougar	*Felis concolor*
Bobcat	*Lynx rufus*
Coyote	*Canis latrans*
Gray wolf	*Canis lupis*
Red fox	*Vulpes fulva*
Blackbear	*Urus americanus*
Ringtail	*Bassariscus astutus*
Opossum	*Didelphis marsupialis*
American marten	*Martes americana*
Fisher	*Martes pennanti*
Shorttail weasel	*Mustela erminea*
Longtail weasel	*Mustela frenata*
Mink	*Mustela vison*
River otter	*Lutra canadensis*
Wolverine	*Gulo gulo luscus*
Spotted skunk	*Spilogale putorius*
Stripped skunk	*Mephitis mephitis*
Dusky shrew	*Sorex obscurus*
Vagrant shrew	*Sorex vagrans*
Pacific water shrew	*Sorex bendirei*
N.water shrew	*Sorex palustris*
Trowbridge's shrew	*Sorex trowbridgei*
Shrew-mole	*Neurotrichus gibbsi*
Broad-footed mole	*Scapanus latimanus*
Pallid bat	*Antrozous pallidus*
Little brown myotis	*Myotis lucifugus*
California myotis	*Myotis californicus*
Fringed myotis	*Myotis thysanodes*
Long-eared myotis	*Myotis evotis*
Yuma myotis	*Myotis yumanensis*
Silver-haired bat	*Lasionycteris noctivagans*
Big brown bat	*Eptesicus fuscus*
Hoary bat	*Lasiurus cinereus*
Long-legged myotis	*Myotis volans*
Townsend's big-eared bat	*Plecotus towsendii townsendii*
Snowshoe hare	*Lepus americanus*
Brush rabbit	*Sylvilagus bachmani*
Pika	*Ochotoma princeps*
Mountain beaver	*Aplondontia rufa*

Mammals (Cont'd):

Yellow belly marmot	Marmota flariventris
California ground squirrel	Citellus beecheyi
Townsend's ground squirrel	Citellus townsendi
Golden-mantle ground squirrel	Citellus lateralis
Townsend's chipmunk	Eutamias townsendi
Western gray squirrel	Sciurus griseus
Northern flying squirrel	Glaucomys sabrinus
Chickaree	Tamiascurus douglasi
Mazama pocket gopher	Thomonys mazama
Beaver	Castor canadensis
Pacific jumping mouse	Zapus trinotatus
Western jumping mouse	Zapus princeps
House mouse	Mus musclus
Deer mouse	Peromyscus maniculatus
Dusky-footed woodrat	Neotoma fuscipes
Bushy-tail woodrat	Neotoma cinerea
Tree phenacomys	Phenacomys longicaudus
Redback vole	Phenacomys albipes
Townsend'd vole	Microtus townsendi
Creeping vole	Microtus oregoni
Porcupine	Erethizon dorsatum
Roosevelt	Cervus elaphus roosevelti
Blacktail deer	Odocoileus hemionus columbianus
Mule deer	Odocoileus hemionus

Avian (Cont'd):

Pileated woodpecker	_Dryocopus pileatus_
American dipper	_Cinclus mexicanus_
Water pipit	_Anthus spinoletta_
Rufus hummingbird	_Selasphorus rufus_
Calliope hummingbird	_Stellula calliope_
Black-headed grosbeak	_Pheuticus melanocephalus_
Chipping sparrow	_Spizella passerina_
Brewer's sparrow	_Spizella breweri_
Savannah sparrow	_Passerculus sandwichensis_
Rufus-sides towhee	_Piplo erythrophtalmus_
Song sparrow	_Melospiza melodia_
House sparrow	_Passer domesticus_
American goldfinch	_Carduelis tristis_
Pine grosbeak	_Pinicola envcleator_
Evening grosbeak	_Coccothraustes vespertinus_
Ruffed grouse	_Bonasa umbellus_
Blue grouse	_Dendragapus obscurus_
Mountain quail	_Oreortyx picta_
California quail	_Callipepula californica_
Wild turkey	_Meleagris gallopavo_
Band-tailed pigeon	_Columba fasciata_
Mourning dove	_Zenaida macroura_
Great horned owl	_Bubo virginianus_
N.Pygmy owl	_Glaucidium gnoma_
N.Saw-whet owl	_Aegolius acadicus_
Great gray owl	_Stix nebulosa_
Long-eared owl	_Asio otus_
Flamulated owl	_Otus flammeolis_
Barred owl	_Strix varia_
Northern spotted owl	_Strix occidentalis_
Turkey vulture	_Cathartes aura_
Sharp-shinned hawk	_Accipter striatus_
Northern goshawk	_Accipiter gentilis_
Coopers hawk	_Accipiter cooperi_
Red-tailed hawk	_Buteo jamaicensis_
Swainson's hawk	_Buteo swainsoni_
American kestrel	_Falco sparverius_
Prairie falcon	_Falco mexicanus_
Peregrine falcon	_Falco peregrinus anatum_
Golden eagle	_Aquila chrysoetos_

Avian (Cont'd):

Bald eagle	Haiaeetus leucocephalus
Osprey	Pandion haliaetus
Raven	Corvus corax
American crow	Corvus imparatus
Common nighthawk	Chordeiles minor
Vaux's swift	Chaetura vauxi
Belted king fisher	Ceryle alcyon
Great blue heron	Ardea berodia
Canvasback	Aythia valisinieria
Redhead	Aythia americana
Ring-necked	Aythia collaris
Lesser scaup	Aythia affinis
Common goldeneye	Bucephala clangula
Cinnamon teal	Anas cyanopterus
Green-winged teal	Anas crecca
Blue-winged teal	Anas discors
Pintail	Anas acuta
Gadwall	Anas strepera
Mallard	Anas platyrhynchos
American widgeon	Anas americana
Common merganser	Mergus merganser
Northern shoveler	Anas clypeata
White-fronted goose	Anser albifrons
Canadian goose	Branta canadensis
Snow goose	Chen caerulescens
Ross's goose	Chen rossii
Sandhill crane	Grus canadensis
White pelican	Pelecanus erythrorhynchus
Sora rail	Porzana carolina
Virginia rail	Rallus limicola
American bittern	Botaurus leniginosus
Green heron	Butorides striatus
Common snipe	Gallinago gallinago

HERPTILES:

Cascade frog	Rana cascadae
Red-legged frog	Rana aurora
Spotted frog	Rana pretiosa
Tailed frog	Ascaphus truei
Pacific tree frog	Hyla regilla
Clouded salamander	Aneides ferreus
Long-toed salamander	Ambystoma macrodactylum
Ensatina	Ensatina eschscholtzi
Pacific giant salamander	Discamptodon ensatus
Rough-skinned newt	Taricha granulosa
Northwestern pond turtle	Clemmys marmorata marmorata
Bullfrog	Rana Catesbeiana
Western toad	Bufo boreas
Western fence lizard	Sceloporus olivaceus
Northern alligator lizard	Gerrhontus coeruleus
Western skink	Eumeces skiltonianus
Sharp-tailed snake	Contia tenuis
Northwestern garter snake	Thamnphis ordinoides
Western rattlesnake	Crotalus viridis

Sources: Key to Mammals of Oregon, B.J. Verts & L.N. Garraway.
Rogue River NF Land Management Plan, 1990.
Crater Lake N.P. Resource Management Plan, 1993.
The Rogue River Analysis and Master Plan, N.B.S.
Sensitive Vertebrates of Oregon, ODFW, 1992.
Neotropical Breeding Bird Surveys, H.Sands, 1992.

APPENDIX E

VEGETATION

BIG BUTTE WATERSHED ANALYSIS

VEGETATION

The health of the Big Butte watershed area forest is tied to the management of disturbance processes. Disturbance is the disruption of succession and is essential to the maintenance of ecosystem stability, biological diversity, resiliency and ecosystem health.

Some species such as Shasta red fir, Pacific silver fir and western hemlock are adapted for establishment and growth in small openings caused by minor disturbances, such as the death or harvesting of a single large tree. This is the characteristic of shade tolerant species which the above species are an example. Seedlings of these species often become established in soils with a litter layer of dead and decaying leaves and branch fragments.

In contrast, other species are well adapted to large openings, created by wildfire, extensive windthrow, flooding, timber harvesting, or agricultural cultivation. Such species are often referred to as "pioneers" and include: Douglas-fir, ponderosa pine and sugar pine. These species can become established and grow rapidly in conditions of bare soil, full sunlight and relatively wide temperature fluctuations associated with large forest openings.

Other species such as incense cedar and white fir are well adapted to openings of intermediate sizes or to disturbances of moderate severity. Many species are able to complete their life cycles in openings of various sizes.

HUMAN INFLUENCES ON VEGETATION IN THE WATERSHED

The Big Butte watershed consists of true fir-hemlock forests and mixed conifer forests. These are forests of conifers in the overstory and broadleaf sclerophyll shrubs and hardwoods in the understory. The true fir-hemlock forests occur at the higher elevations on mid and upper slopes. Climate is cool and wet; snowpack is present up to 8 months each year. The mixed conifer forests occur on drier sites and at lower elevations.

Forests have been altered by human use to cause the ecosystem to lose some of its natural survival mechanisms against fire, insects and disease.

Once, original forests consisted of open stands dominated by more drought-resistant ponderosa and sugar pines and the Douglas-fir and true firs remained clustered in riparian areas and on shady north slopes and at the higher elevations.

Prior to the establishment and protection of the Forest Preserves at the turn of this century, Native Americans, trappers, miners, and homesteaders had a profound effect on the fire regime. The Native Americans gathered berries and medicinal plants and burned for hunting, berries and roots yearly. Trappers (the Hudson Bay Company from 1828) used fire indiscriminately to drive game, miners used fire to rid the woods of pests and expose rock outcrops, and homesteaders utilized fire to assist in clearing their land. The regular burning by Native American tribes and lightning fires helped retain the optimal density of the forest trees and maintained the pioneer and early seral species such as the pines in the stand composition.

Harvesting as practiced in the period of the 1880s through the mid-1940's tended to selectively harvest the dominant, large diameter sugar pine and ponderosa pine and, later in the period, the dominant Douglas-fir in the stands. Harvesting demanded large timber and what remained tended to be inferior trees long suppressed in the understory --- generally white fir.

Homesteaders would select large diameter sugar pine to make high quality shakes and shingles. Homesteaders also cleared land for their cabins, barns and orchards, but these areas were relatively small in size due to the great amount of effort to fell large conifers with only an axe.

The Forest Service (Crater National Forest) first appraised the timber stands of the Big Butte Watershed in 1909, updating the appraisal in 1917, and making a report in January, 1920. The report was to promote the area for development and encourage a railroad system to be built into the area to facilitate harvest of the timber.

An investor was found to bid on the timber and begin constructing a railroad into the Big Butte Watershed in the 1920s. Between 1925 and 1932 nearly 100 million board feet of timber was harvested from the Fourbit Creek drainage of the watershed. During this time all snags were felled as a matter of practice. Heavy ten ton tractors were utilized to skid out the felled timber to the waiting railcars. Slash was piled by the tractors but not always burned. Burning of piles tended to be done immediately adjacent to the rail lines to minimize fuels hazard in the area. It was intended to leave at least 15% of the original stands (10" Dbh and greater) in the Fourbit Creek drainange. However, the amount of dwarf mistletoe (witches brooms) infection and the normal amounts of disease expected in a vast tract of overmature Douglas-fir and ponderosa pine as in the Fourbit Basin gave foresters of the era great concern and trees with those indicators were not allowed in the residual stand.

Reforestation was by natural seedfall until sometime in the 1930s when limited artificial reforestation was attempted through broadcast seeding and placing small seed caches protected from the rodents and birds.

Following World War II harvesting became less discriminant with the post war building boom. Diameter-limit cuts were prevalent throughout the 1940s and 1950s and tended to promote a more even-aged condition by taking all larger diameter trees. In some stands these trees occur in two or three age classes; the origin of each age class followed a fire or other major disturbance, such as a windstorm or tree harvest.

Reforestation using nursery seedlings began in the late 1940s when harvesting increased to a point where natural regeneration could no longer be relied upon to keep up with the rate that openings were created in the forest. Stocking, however, was not always from known, or worse, local seed sources. This has led to some second growth stands not producing at the expected level by the site potential.

There was a gradual shift to individual tree selection cuts to group selection cuts and then block clearcutting by the late 1950s.

Clearcutting dominated the 1960s until chronic reforestation problems led to a decrease in clearcutting on most federal lands nationwide. Reforestation technology and knowledge about the affects of compaction on crop tree survival and long-term site productivity were limited.

By the 1970s two-stage shelterwood harvesting with some underplanting where natural regeneration was unreliable was the preferred silvicultural treatment. Harvesting since the mid-1970's has shifted away from even-aged management to more uneven-aged or selection harvesting. This was not done so much as a response to the needs of the watershed as it was a response to the political and social pressures of the era. When and where properly executed, however, uneven-aged management has tended to create stands of multiage with greater structural and species diversity.

By the 1980s clearcutting had again come into favor on federal lands but shared importance with the shelterwood system. Again, this shift can be attributed to the political and social desires of the times and not necessarily those of the watershed needs.

In the 1990s clearcutting once again has lost favor on federal lands and is the selected silvicultural system only where insects, disease or another non-short-term economic need is evident. Presently harvesting is by shelterwood, commercial thinning or a modification of a group selection cut.

Selective harvesting has increased root disease inoculum levels by creating cut-stumps and open wounds on residual trees, both of which act as infection courts. It also increases the food base available to some root disease-causing fungi. Increased wounding levels in residual trees also favors high rates of colonization by stem decay fungi.

Insect and disease activity has increased since the turn of the century as a result of fire exclusion, introduction of exotic organisms and management activities. In historic times, periodic fires kept stocking levels low to moderate. Dwarf mistletoe infection levels were relatively low because ground fires destroyed both infected understories and heavily infected overstory trees with large brooms close to the ground. Shade tolerant trees, generally more susceptible to root diseases and stem decays than seral species, were also limited by frequent fires.

Grazing is prohibited in the Sky Lakes Wilderness. Opportunities and quality forage increases at the lower elevation, mixed conifer stands where species diversity is at its greatest in the watershed.

Tree growth on some sites has been reduced by heavy compaction of soils by tractors or rubber-tired machines used for moving logs, piling of logging debris, removing unwanted trees or shrubs, and multiple entries.

Stand growth frequently is limited by available nitrogen, most of which is stored near the soil surface. Therefore, site disturbances to promote regeneration must be done with great care so topsoil is not lost or displaced.

Fire exclusion became policy for the forest reserves and national forests shortly after the turn of the century, but control efforts became effective in the forties when suppression was mechanized after the war and prevention campaigns and enforcement of regulations prohibiting fire were taken seriously.

MANAGEMENT IMPLICATIONS BY VEGETATIVE COMMUNITIES

The Big Butte watershed is a portion of the Cascade Province for vegetation and is further subdivided into the Rogue Western Cascade Subprovince (mixed conifer forests) and the Rogue High Cascade Subprovince (true fir-hemlock forests).

The forests can be further classified into series and yet further into plant associations to aid us in understanding vegetative relationships of composition, competition and structure. Series are defined by their dominant climax species or the mid-seral regeneration layer of the stand.

WHITE FIR SERIES

White fir stands are usually dominated by Douglas-fir in the overstory until late in succession. Litter production is high, biomass production is high and fuels dry quickly. It is the most commonly occurring, most diverse and one of the most productive series in the Big Butte watershed. Fire is the dominant agent of disturbance to the white fir series, followed by human influenced disturbance, wind, disease and insects.

This is the most diverse and productive of the series in the watershed. General management directions for this series is difficult because it is so diverse. Site-specific analysis is essential. Management considerations are given by Association. In general, though, maintaining soil organics and structure on all sites of the white fir series will moderate extremes and increase the water-holding capacity and thereby the survival rate of regeneration.

ABCO-ABMAS/CHUM (white fir-Shasta red fir/prince's pine)

Elevation(in feet)	Mean: 4900	Range: 4400-5450	Actual: 4200+
Aspect	Mean: SSW	Range: E-NNW	Actual: NE-NW
Slope %	Mean: 24	Range: 5-45	
Total Basal Area (ft2/acre)	Mean:320	Range: 230-410	

Parent materials are gradations of andesite or basalt.

The mean annual temperature is one of the lowest of the White Fir Series and the maximum monthly temperature is the lowest. Moisture is available throughout most of the growing season. However, stress may develop at the end of the growing season. Cold temperatures will also affect growth rates at both ends of the growing season, limiting biomass production.

Potential for natural regeneration is estimated to be moderate.

This Association has a higher average basal area than the Series.

Vegetation competition from brush usually does not diminish timber volume production.

Compaction as a result of management activities can lessen survival and growth.

Vine maple and Pacific rhododendron are potential vegetation management problems where they occur.

Douglas-fir, white fir, Shasta red fir, incense cedar, western white pine, Englemann spruce, sugar pine, mountain hemlock, and Pacific yew are all appropriate species for regeneration. On the colder, frost-prone sites, Shasta red fir and western white pine should be favored with mountain hemlock on the coldest depressions, and Englemann spruce in the cold, moist drainages. On the relatively warmer, drier microsites, Douglas-fir, incense cedar and sugar pine would be well adapted.

Overstory is composed of white fir, Shasta red fir (indicates cold, moderate conditions), incense cedar, Englemann spruce (cool, moist-wet sites), sugar pine (established under warmer conditions), western white pine, ponderosa pine (evidence of past fire history), Douglas-fir, and mountain hemlock (found on cold, wet sites).

Understory is composed of white fir, Shasta red fir, incense cedar, Englemann spruce (good in areas with poor drainage), sugar pine, western white pine (cold or frost-prone areas), Douglas-fir (warmer sites), Pacific yew (moist sites with high humidity), western hemlock, mountain hemlock (suitable for the coldest sites), vine maple, Douglas maple, Pacific madrone (indicates fire history), and golden chinquapin (shallow, rocky soils).

Herbaceous cover indicators:

dwarf Oregongrape	deep, fertile soils
Piper's Oregongrape	dry, rockier, less productive sites than those with dwarf Oregongrape
Fremont silk-tassel	generally found on hot, dry sites
Pacfic rhododendron	shallow, well drained soils
dwarf bramble	cool to cold, moist sites
snow bramble	cool, moist forests
thin-leaved huckleberry	cool sites, well drained soils
grouse huckleberry	cold, high elevation sites

ABCO/RUNI/ACTR (white fir/snow bramble/vanillaleaf)

Elevation (in feet)	Mean: 4000	Range: 3400-4600	Actual: 3600-4200
Aspect	Mean: SSE	Range: E-SW	Actual: N,NW,W
Slope %	Mean: 26	Range: 16-31	
Total Basal Area			

(ft2/acre) Mean: 340 Range: 255-425

Herb cover is the highest of the Series.

Parent materials are andesite or basalt and have produced deep soils.

This Association has one of the greatest average basal areas per acre of the White Fire Series.

Litter cover is the lowest of the White Fir Associations (associated with the warmer temperatures of these sites; faster decomposition rates).

Douglas-fir dominates the overstory, but white fir and incense cedar are common. In the understory white fir dominates, with Douglas-fir and incense cedar common. Sugar pine, Douglas-fir, and incense cedar are found on the warmer, drier sites and golden chinquapin on the shallow, rockier sites. Western hemlock is found on the wetter sites and Pacific yew is found in humid pockets.

White fir and Douglas-fir will invade after disturbance.

White fir, and on the wetter sites, western hemlock, are suited for uneven-aged management.

White fir, Douglas-fir, incense cedar, and sugar pine are appropriate for regeneration. Utilize rust resistant sugar pine due to the high occurrence of Ribes species in this Association.

Herbaceous cover indicators:

dwarf Oregongrape	deep, fertile soils
Piper's Oregongrape	drier, rockier, less productive sites
prince's pine	low light levels
red-osier dogwood	moist, well-drained soils
Oregon boxwood	moist conditions, well-drained soils
sticky currant	drier sites
dwarf bramble	cool to moist sites
snow bramble	coil, moist forests
creeping snowberry	warm, dry slopes
thin-leaved huckleberry	cool sites, well-drained, acidic soils
vanillaleaf	moist areas on deep, well-drained soil
trail-plant	moist sites
threeleaf anemone	cool, wet sites
leafy peavine	fixes nitrogen
Indian-pipe	saprphyte (decomposes litter, duff)

starry false Solomon's-seal	cool sites
foamflower	cool, moist, deep fertile soils

ABCO/VAME/LIBOL (white fir/thin-leaved huckleberry/western twinflower)

Elevation (in feet)	Mean: 4800	Range: 4700-4950	Actual: 4200-5000
Aspect	Mean: NW	Range: WSW-NE	Actual: N-SE,NW
Slope %	Mean: 14	Range: 0-30	
Total Basal Area (ft2/acre)	Mean: 245	Range: 175-320	

This Association is found at the highest elevations of the White Fir Series.

Parent materials are andesite and basalt and soils are the deepest of the Series.

Temperatures are among the lowest of the White Fir Series. Low soils and air temperatures combined with moisture limitation late in the growing season limit biomass production.

White fir, Douglas-fir, western white pine, sugar pine, and Pacific yew are appropriate for regeneration. On the colder, frost-prone sites western white pine should be favored, but stock should be of high rust resistance. On the relatively warmer, drier microsites, Douglas-fir and sugar pine would be well adapted.

The potential for natural regeneration is estimated to be moderate.

White fir and Douglas-fir would be the best producers on these sites.

Overstory is composed of white fir, Shasta red fir (indicates cold, moderate conditions), western white pine (indicates cold conditions), and Douglas-fir (warmer sites).

Understory is composed of white fir, sugar pine, western white pine (frost tolerant), Douglas-fir (warmer sites), Pacific yew (sites with high humidity), Douglas maple, and golden chinquapin (shallow, rocky sites without cold air accumulation).

Herbaceous cover indicators:	
prince's pine	dry, cool to warm conditions
Oregon boxwood	moist conditions, cool sites, generally well-drained soils
willow	moist conditions
thin-leaved hucklberry	cool sites, well-drained, acidic soils
common yarrow	thrives in dry, disturbed areas
threeleaf anemone	wet, cool sites
queen's cup	well-drained soils, generally on sites with frost and deep snowpack
western twinflower	abundance indicates relatively little soil drought
three-tooth mitrewort	cool forest conditions
one-sided pyrola	prefers a thick duff layer
starry false Solomon's seal	generally cool sites
white trillium	moist sites
white inside-out flower	warm, moist, lower elevations

ABCO/ACGL/BENE (white fir/Douglas maple/dwarf Oregongrape)

Elevation (in feet)	Mean: 4200	Range: 3900-4500	Actual: 3600-4200
Aspect	Mean: NW	Range: W-NNE	Actual: N,NW,W
Slope %	Mean: 38	Range: 15-60	
Total Basal Area (ft2/acre)	Mean: 220	Range: 130-310	

Parent materials are andesite and basalt with one of the deepest total soil depths of the White Fir Series.

Moisture is the most limiting factor to biomass production for this Association.

White fir, Douglas-fir, incense cedar, western white pine, and sugar pine are appropriate for regeneration. Western white pine has the best chance of survival and growth on colder sites. Both western white pine and sugar pine stock should be of high rust resistance due to the presence of Ribes species and the threat of blister rust infection.

The total basal area for this Association is one of the lowest of the White Fir Series.

round-leaved violet	mesic sites
beargrass	cold, dry to moist sites

ABCO-PSME/BEPI (white fir-Douglas-fir/Piper's Oregongrape)

Elevation (in feet)	Mean: 3250	Range: 2600-3900	Actual: 3600-5000
Aspect	Mean: SW	Range: S-W	Actual: S-NW
Slope %	Mean: 36	Range: 15-55	
Total Basal Area (ft2/acre)	Mean: 300	Range: 230-375	

Parent materials are varied, ranging from ash/tephra to diorite/gabbro, but the majority is andesite/basalt.

Moisture limitation late in the growing season limits biomass production.

White fir, Douglas-fir, incense cedar, sugar pine, western white pine, and ponderosa pine are all appropriate for regeneration. Western white pine ans ponderosa pine would be suitable for frosty microsites.

Overstory is composed of white fir, Shasta red fir (found on cold, moderate sites), incense cedar (co-climax, fire resistant), sugar pine (more seral in behavior in this Association), western white pine (less susceptible to root disease), ponderosa pine (evidence of fire history where present), Douglas-fir, and western hemlock.

Understory is composed of white fir, incense cedar, sugar pine (somewhat drought tolerant), western white pine (intermediate in light tolerance), ponderosa pine (hot, dry sites or frosty sites), Douglas-fir, Pacific yew (slow growing), western hemlock (warmer, moister sites), vine maple, big-leaf maple (moist areas), Pacific madrone (evidence of recent fire history), golden chinquapin (shallow, rocky soils), and canyon live oak (hot, dry conditions).

Herbaceous cover indicators:

dwarf Oregongrape	deep, fertile soils
Piper's Oregongrape	drier, rockier, less productive sites than those with dwarf Oregongrape
deerbrush	regeneration will be stimulated by fire
Fremont silk-tassel	dry, sunny sites
hairy honeysuckle	indicates hot, dry sites, often rocky, well-drained soils

trumpet honeysuckle	dry sites
poison oak	hot, dry or recently disturbed sites
creeping snowberry	warm, dry slopes
thin-leaved huckleberry	cool sites, well-drained soils
bunchberry	indicates cool, mesic sites
leafy peavine	fixes nitrogen
lupine species	fixes nitrogen
western swordfern	generally productive sites
bracken fern	often invades after heavy disturbance
one-sided pyrola	prefers thick duff layer
white trillium	moist sites

RED FIR SERIES

The Red Fir Series occurs at high elevations in a narrow band between the Mountain Hemlock Series and the White Fir Series. This series tends to have deep, fertile soils. Biomass production can be high, but is limited by cold soil temperatures and lower decomposition rates. Fire is most frequently the most common major disturbance followed by human influenced disturbance, wind, disease, ice and snow.

ABMAS/VAME (Shasta red fir/thin-leaved huckleberry)

Elevation (in feet)	Mean: 5300	Range: 4800-5800	Actual: 5000+
Aspect	Mean: NNW	Range: W-N	Actual: E,SE,S
Slope %	Mean: 13	Range: 0-30	
Total Basal Area (ft2/acre)	Mean: 310	Range: 160-450	

Sites are equally likely to be on ash or basalt. Basalt sites are productive and usually well developed. Ash sites are relatively infertile, young and fragile. Ashy, shallow soils on slopes less than 15% may have killing frosts.

Shasta red fir dominates the stands. Many stands have a high cover of lodgepole pine but will always remain in a subordinate position. Douglas-fir and white fir significantly influence site characteristics --- by providing understory vertical structure, and cycling of needles and branches to the forest floor.

Mountain hemlock presence indicates cold temperature conditions.

Long-stolon sedge is a barrier to reforestation.

Overstory is composed of white fir (productive), Shasta red fir (productive), lodgepole pine (subordinate), mountain hemlock (cold sites), Douglas-fir and western white pine.

Understory is composed of white fir, Shasta red fir, mountain hemlock, lodgepole pine, western white pine, golden chinquapin (shallow, rocky soils).

Herbaceous cover indicators:	
pinemat manzanita	rocky sites
western twinflower	abundance indicates relatively little soil drought
queen's cup	generally on sites with frost and deep snowpack
western wild ginger	wet sites
beargrass	drier sites

WESTERN HEMLOCK SERIES

The Western Hemlock Series occurs on lower elevations and, in the Big Butte watershed, along creeks and in association with riparian areas. This series is highly productive. Self-pruning and mortality are low, even through mid-seral stages and litter accumulation is low until late successional stages. The series has the highest occurrence of human influenced disturbance, although fire is still the most frequently observed event. Wind is a frequent disturbance agent as western hemlock is known to have shallow root systems. Sugar pine, incense dear, and ponderosa pine are excellent performers on drier, warmer, or more basic soils. Competing vegetation can be a problem even following bruning for site prep prior to planting.

TSHE/ACGL/LIBOL (western hemlock/Douglas maple/western twinflower)

Elevation (in feet)	Mean: 3900	Range: 3650-4100	Actual: 3600-5000 ft
Aspect	Mean: WNW	Range: SSW-NE	Actual: N,E-NW
Slope %	Mean: 30	Range: 5-53	
Total Basal Area (ft2/acre)	Mean: 311	Range: 240-380	

Parent material is usually basalt and is most fertile.

This is the only cool, dry Association.

Cold temperatures may limit decomposition rates, but frost is not likely to kill.

Moisture stress annually reduces growth rates.

Western hemlock probably most efficient biomass producer with bigleaf maple, Douglas-fir, and white fir close behind. Sugar pine is productive on warmer sites. Western white pine is productive on most sites.

Bigleaf maple, snowbrush, golden chinquapin, and vine maple are most serious competitors.

Wildlife browse: Pacific dogwood, hazel, Pacfic blackberry.

The overstory is composed of white fir, incense cedar, sugar pine,western white pine (cold site), Douglas-fir (warmer, drier site), and western hemlock (climax species).

The understory is composed of white fir, incense cedar (warmer, drier sites), Englemann spruce, Douglas-fir, western hemlock, Pacific yew, Douglas maple, vine maple, and golden chinquapin (warmer, drier conditions).

Herbaceous cover indicators:

ocean-spray	warm, dry local conditions
Pacific hound's tongue	dry sites with shallow soils
western twinflower	abundance indicates relatively little soil drought
bracken fern	may be allelopathic
stream violet	warm, moist sites
white inside-out flower	warm, moist sites
swordfern	generally on productive sites

TSHE/BENE/LIBOL (western hemlock/dwarf Oregongrape/western twinflower)

Elevation (in feet)	Mean: 3400	Range: 2800-4100	Actual: 3600-4200
Aspect	Mean: N	Range: WSW-ESE	Actual: SW, W-N

Slope %	Mean: 30	Range: 10-50
Total Basal Area (ft2/acre)	Mean: 254	Range: 170-340

Most common parent material is andesite. Soils are deep, fertile, and resilient.

One of the most diverse Associations of the Series.

Bigleaf maple and snowbrush are most likely to compete with conifers, but need for vegetation control is relatively low on most sites.

Monitor stocking levels of these diverse stands --- not much is known about density management in such stands.

Douglas-fir dominates upper layer of canopy; western hemlock dominates the lower canopy. Other species present are scattered vertically throughout the stand.

Sugar pine, incense cedar, Pacific madrone are well adapted and productive. White fir, lodgepole pine and western white pine perform well on cooler sites. Ponderosa pine, canyon live oak, golden chinquapin are pioneers on dry, less productive sites. Shasta red fir, Pacific silver fir occur rarely and on the very coolest sites.

Potential for natural regeneration is high.

The overstory is composed of Pacific silver fir (rare), white fir (cooler site), Shasta red fir (rare), incense cedar, sugar pine, western white pine (cooler site), Douglas-fir (warmer, drier site), and western hemlock (climax species).

The understory is composed of white fir, incense cedar (tolerates extremes), sugar pine (productive on warmer sites), Douglas-fir, western hemlock, Pacific yew (occupies humid microsites), bigleaf maple (occupies humid microsites), Douglas maple (tolerates dry and rocky to moist slopes), vine maple, Pacific madrone, canyon live oak, and golden chinquapin (drier, less productive sites).

Herbaceous cover indicators:	
bracken fern	may be allelopathic
white inside-out flower	warm, moist sites
swordfern	generally on productive sites
dwarf Oregongrape	deep, fertile soils
Piper's Oregongrape	drier, rockier less productive sites than dwarf Oregongrape

common prince's-pine	dry sites
Oregon boxwood	cool sites
creeping snowberry	disturbance indicator
whipplevine	warm, dry sites at low elevations, often rocky
vanillaleaf	moist sites, deep, well drained soil
queen's cup	indicates cool, moist sites
white-flowered hawkweed	warm, dry, disturbed sites
candyflower	moist sites
one-sided pyrola	cool, moist conifer forests
starry Solomon-plume	generally cool sites
foamflower	moist environment
beargrass	resprouts quickly following fire

MOUNTAIN HEMLOCK SERIES

The Mountain Hemlock Series occurs at high elevations. It is similar to the Western Hemlock Series with respect to litter production, but biomass production is low. It has a tendency to occur on cold, northerly aspects. On southerly aspects, it is often replaced by the Red Fir Series. Terrain is commonly flat or gently sloping. Fire occurrence in mountain hemlock is lowest for all the series. Sites are cold, flat and moistened from summer thunderstorms. Ice and snow are significant disturbance agents. Disease, especially root disease, is common in older mountain hemlock stands and in some areas controls stand dynamics.

Management oppotunities for this series are limited by deep, persistent snow pack, a short, cool growing season, and poorly developed soils. Reforestation is difficult, but can be hastened by keeping harvest openings small to maximize edge effect. Fall, rather than spring, planting will probably afford the best success.

Care should be taken to keep the litter layer intact as the soil organic matter acts to moderate extremes in soil moisture and temperature, increase fertility, and reduce surface erosion.

TSME-ABMAS/VAME (Mountain hemlock-Shasta red fir/thin-leaved huckleberry)

Elevation (in feet)	Mean: 5400	Range: 5100-5800	Actual: 4200-5000+
Aspect	Mean: NNW	Range: SW-NE	Actual: N,NE,SW,W,NW

Slope %	Mean: 22	Range: 7-36
Total Basal Area (ft2/acre)	Mean: 270	Range: 200-340

Cold temperatures (frost, cold soils) is the most limiting factor in this Association.

Soils on basalt are usually shallow and rocky. Basaltic sites are generally more fertile than pumice or ash.

Shasta red fir and mountain hemlock dominate the stand.

Warmer climaitc sequences will have Shasta red fir regeneration favored with white fir and Douglas-fir also occurring.

If parent material of soil is pumice western white pine will have a competitive advantage.

Cold climatic sequence will favor mountain hemlock and western white pine.

Shasta red fir is best producer of conifers in this Association.

This is the upper range limit for sugar pine and not the best site.

Growth rates for all confiers will be relatively slow.

Disturbed sites are slow to recover particularly on pumice.

Overstory is composed of white fir, Shasta red fir, incense cedar, mountain hemlock, Englemann spruce (moist areas), western hemlock, sugar pine (warm sites), western white pine, and Douglas-fir (protected sites).

Understory is composed of white fir, Shasta red fir, Douglas-fir (favored in warm periods), Englemann spruce (plant in wet areas), sugar pine (at the upper end of its range), western white pine, western hemlock, mountain hemlock (dominant), Douglas maple, and golden chinquapin.

Herbaceous cover indicators:

western twinflower	indicates site potential for sugar pine
Oregon boxwood	indicates moist conditions
pinemat manzanita	poor, cool sites
prince's pine	drier sites

dwarf bramble	revegetates disturbed areas
Pacific blackberry	revegetates disturbed areas

RELATIONSHIP OF VEGETATION TO THE ENVIRONMENT

Stands developing after major disturbances have been described as "even-aged" stands, since all component vegetation have been assumed to regenerate shortly after the disturbance. In reality vegetation continues to regenerate for several decades following a disturbance before available growing space becomes fully utilized. This results in a wide age range for the stand. For this reason it is probably more accurate to describe stands in terms of an age class or a cohort. therefore, a group of trees regenerating after a single disturbance is a cohort with the age range within the cohort as narrow as 1 year or as wide as several decades depending on the length of time for trees to invade following a disturbance. Stands developing after a major disturbance are single-cohort stands. Stands where component trees arose after a series of minor disturbances are termed multiple-cohort or multicohort stands. The traditional designation for multiple-cohort stands has been uneven-aged stands.

FOUR DEVELOPMENT PATTERNS OF STANDS FOLLOWING A DISTURBANCE

STAND INITIATION STAGE

After a disturbance, new individuals and species continue to appear for several years.

A major disturbance radically changes the forest floor and soil environment even if it does not destroy them. The natural processes for soil development is interrupted and nutrients are lost. Species composition of a stand is largely the result of the type of disturbance which inititiated it. The type and severity of the disturbance determines which species have the initial advantages and competitive advantages. Soil, climate, available sunlight, moisture and nutrients will influence which species have a competitive advantage. Individuals will continue to invade the area as long as growing space is available.

The stand initiation stage, which is before the growing space is fully reoccupied and new stems quit initiating, is the time of very high numbers of plant species. It is also a period when many animals are found, since the variety of plants and seeds provides an abundance and diversity of food.

STEM EXCLUSION STAGE

After several years, new individuals do not appear and some of the existing ones die. The surviving ones grow larger and express differences in height and diameter; first one species and then another may appear to dominate the stand.

Before the available growing space is reoccupied, plants are expanding in an open growth condition, unrestrained by competition with other individuals. After the available growing space is reoccupied, new individuals do not become established successfully. Those plants with a competitive advantage in size or growth pattern are able to expand into growing space occupied by other plants and reduce their growth rate or kill them.

A given stand may have only parts of it in this stage and the may take several decades before all parts make the transition from the stand initiation stage to the stem exclusion stage.

The foliage layer rises as the trees grow taller, and leaves cannot survive in the diminished sunlight beneath it. Plants which cannot grow tall enough to stay within the uppermost foliage layer often die. The shaded forest floor becomes devoid of living plants and consists of the dead and decaying leaves, stems and twigs.

Four Crown Classes

The degree of dominance in the stand foliage layer is described by classifying trees into four crown classes.

DOMINANT. Crowns extend above the general level of crown cover of other trees and are not physically restricted from above, although possibly somewhat crowded by other trees on the sides.

CODOMINANT. Crowns form a general layer together and are not physically restricted from above, but are more or less crowded by other trees from the sides.

INTERMEDIATE. Trees are shorter, but their crowns extend into the general level of dominant and codominant trees, free from physical restriction from above, but quite crowded on the sides.

SUPPRESSED (OVERTOPPED). Crowns are entirely below the general level of dominant and codominant trees and are physically restricted from immediately above.

UNDERSTORY REINITIATION STAGE

Later, forest floor vegetation and advance tree regeneration again appear and survive in the understory, although they grow very little due to reduced resources such as sunlight, soil moisture and nutrients.

As the overstory grows older new vegetation appears in the forest floor. These are usually species capable of living under low-intensity, high shade and can be the same as or different from species in the overstory and those shrubs and herbs which grew during stand initiation.

In a literal sense, the stand would no longer be a single cohort after the forest floor stratum develops. In practice, however, a stand is still considered to have a single cohort until younger trees from the forest floor grow much larger.

The understory reinitiation stage generally contains more animal species than does the stem exclusion stage, but fewer than the stand initiation stage. Understory plants generally contain less starch nutrition for animals than those growing in full sunlight. Many animals are particularly adapted to growing in this stage and in the subsequent old growth stage, during which they utilize the woody debris built up on the forest floor for food and shelter. A large animal population can prolong the time before the understory reinitiation stage appears by browsing forest floor vegetation while it is very small.

OLD GROWTH STAGE

Much later, overstory trees die in an irregular fashion, and some of the understory trees begin growing to the overstory.

Old growth describes a condition achieved by a unique development sequence and not the diameter size or necessarily the age of the trees in the stand. When the trees which invaded immediately after the major disturbance have all died, the stand enters a true old growth condition. But when young trees at first grow into the overstory, while some relic trees from a previous disturbance remain alive this condition is referred to as transition old growth.

The term "old growth" has also been used to describe stands of specific structural characteristics. Structural features include large, living old trees; large, dead standing trees, massive fallen logs; relatively open canopies with foliage in many layers; and diverse understories. Such structures are achieved by a variety of major and/or minor disturbance patterns in a single- or mixed-species stands; therefore, they do not represent a unique stage of forest development. In addition, stands of species such as lodgepole pine which do not grow large or old or species which decompose rapidly would never achieve the structural definition of old growth attributed to Douglas-fir stands. Through stand management, old growth structures can be created much more quickly than through natural processes.

The old growth stage probably has the greatest horizontal and vertical variation in structure, with both large and small trees growing in separate and intermixed patches. The number of plant and animal species found is generally more than in the stem exclusion or understory reinitiation stages but less than in the stand initiation stage. A few plants and animals are dependent on the rotting wood or large limbed nesting trees found exclusively in these old growth forests for their survival. The northern spotted owl seems able to exist only in forests with these old growth structures.

How rapidly a forest changes from one stage to the next varies greatly. If a disturbance occurs the stages begin all over once more.

APPLICATIONS TO MANAGEMENT

Management of stands does not alter a "natural direction" of forest development, since no obligatory direction occurs. Patterns are repeatable due to plant interractions and not by driving forces. Silvicultural operations are tied to the stages of stand development. Applying operations during an inappropriate stage makes them much more difficult and costly or virtually impossible to implement successfully. Some operations may not be necessary if the natural stages of development are known and anticipated: since advance regeneration becomes established during the understory reinitiation stage, planning for this form of regeneration of a desirable species can avoid the cost of artificial reforestation.

The stem exclusion stage can be prolonged with light thinnings of the intermediate and suppressed overstory trees, and shortened by heavy thinnings which allow and understory to develop. The understory reinitiation stage can also be prolonged by light thinnings which stabilize the overstory, or shortened by heavy thinnings which allow the advance regeneration to grow upward, creating a structure resembling old growth.

Operations such as release and weeding and planting or interplanting to alter the species composition of the new stand are most efficient during the stand initiation stage. Trying to adjust the species composition by adding species during the stem exclusion stage is nearly impossible. Both fires and insect attacks tend to occur during the stem exclusion stage; activities such as thinning can reduce or increase the risk of fires or insects. Progressively older stands become more susceptible to windthrow as the trees grow taller. Maintaining a closed canopy at the end of the rotation will retard the encroachment of competing vegetation that would otherwise be a control problem in the subsequent rotation.

Severe competition from sedges and grasses often inhibit seedling establishment and growth in the Big Butte watershed. Heavy equipment used for logging often only aggravates the sedge competition problem.

INFLUENCES ON STAND COMPOSITION AND CONFIGURATION

Fire is an important agent of disturbance. Very few forest stands show no evidence of fire disturbance at some time during their development.

Most tree species and many shrub species of the Big Butte watershed have adaptations to cope with periodic wildfires. Pacific madrone and live oaks sprout vigorously from root crowns or the base of the trunk, even after being severely burned. Many hardwood seedlings or saplings develop root burls so that they can sprout after fires. Other species develop thick bark to insulate against heat injury, such as ponderosa pine, sugar pine and mature Shasta red fir and Douglas-fir. Some species such as lodgepole pine take advantage of wildfire-created openings by having cones that stay closed until heated. Douglas-fir, hemlock and white fir can disperse their seed via wind over considerable distances to burned-over areas.

The stand condition, composition and plant communities of the Big Butte watershed prior to harvesting activities was very different than the conditions viewed today. Fire exclusion and selective harvest of the dominant trees within the stands have change the watershed from a pine-dominated late seral or stand of old growth characteristics, to one of that dominated by second-growth pole to medium-sized sawlog stands of shade-tolerant species such as white fir, Douglas-fir and hemlock. Areas of second-growth dominated by pines today are those achieved by artificial reforestation. Very few sugar pine and ponderosa pine of large diameter remain that once dominated the watershed.

Within the Big Butte watershed some major stand replacement fires occurred. The Cat Hill Burn occurred in 1910 and the area had also burned extensively prior to that sometime between 1880 and 1910. The Cook Burn also occurred around 1910. Numerous smaller stand replacement fires have occurred in the Watershed especially in the time period of 1880s through 1930s. Fire suppression has become a primary objective in the Watershed. Fire has been excluded except for the prescribed burns designed to reduce the fuels hazard created by harvest operations. Beginning in 1994 fire has been utilized as a tool to control stand densities especially where pines are to be kept as a healthy and dominant component of the stands.

Flood events are infrequent in the Big Butte watershed. This area is the headwaters of the Big Butte drainage area and the streams that feed Big Butte Springs and Big Butte Creek. The risk from flood is very low.

Other than the great Columbus Day storm of October 12, 1962, only isolated, relatively small areas have been disturbed due to wind. Stands most susceptible to windthrow are those that have been thinned late in the stand's stage of development. Such stands have trees with poor root structures due to overstocked conditions during stand development.

Frost damage can be a serious inhibitor to seedling establishment and growth in the flatter portions of the Big Butte watershed. Large tracts of flat topography do not exist in the upper Big Butte watershed and therefore frost is not seen as a major inhibitor to seedling establishment.

Pocket gophers, porcupines, deer and elk browsing are serious inhibitors to seedling establishment, growth loss and sometimes mortality in the Big Butte watershed. Many stands require protection from animal damage if regeneration is to be successful.

FUTURE TRENDS IN VEGETATION

Given enough time, and without major disturbances, mountain hemlock and white fir will replace Douglas-fir and western white pine in the true fir-hemlock stands; western hemlock, white fir and incense cedar will replace Douglas-fir, sugar pine and ponderosa pine in the mixed conifer stands.

Each plant series has a distinct environment associated disturbance regime. The series environment and its disturbance regime should be understood and incorporated into management prescriptions. Plant association work done by Tom Atzet and other Area Ecologists give recommendations for management of sites based on the plant community and environment.

Evaluating the need for vegetation management at any point in stand development requires the effects of competing vegetation on future stand development be determined. In order to assess the potential competing vegetation to influence stand development, several predictions should be made:

-- The growth and development of the competing species.

-- The effect of various types and amounts of competing vegetation on the survival and growth of crop trees.

-- The effect of possible treatments on the competing species present in a stand and on the potential invasion of other species from adjacent stands or residual seed.

Based on these predictions, several questions about the rate and course of stand development can be asked:

-- Will the desired stand develop in the allotted time under projected levels of competition?

-- Will the effects of competition reduce growth but allow the desired stand to eventually develop?

-- Will competition cause a reduction in both growth and final yield of the stand?

-- Will competition cause serious mortality and growth reductions such that a manageable stand will not develop?

To reduce the risk of lowering site productivity, forest resource managers should reduce usage of ground equipment, or restrict use to periods when soil conditions make heavy compaction less likely. Even pumice and ash soils, once considered uncompactable, can be damaged and have productivity greatly reduced by the indiscriminate use of heavy equipment.

Not managing stand densities will invite insect epidemics and accelerated mortality thereby increasing fuels loadings and the fire risk. Not managing stand densities will also promote the shift of stand composition away from shade intolerant or pioneer species such as pines toward a stand of shade tolerant species such as Douglas-fir, true firs (white fir and Shasta red fir), and hemlocks (western hemlock and mountain hemlock).

Natural plant communities and plant associations are best able to withstand drought and natural attacks by fire and insects.

Deposition of cones, needles and branches is usually at a rate much faster than decomposition causing litter to accumulate and thereby increasing the fuels hazard of an area. Prescriptive fire can be utilized as a management tool to maintain or improve the health of the ecosystem if used with the knowledge of the plant association appropriate for the site. But even prescriptive fire should be used judiciously and with caution. Soil exposures to temperatures of 482 degrees Fahrenheit for only 10 minutes is the minimum required to intiate cementation effect and the soil becomes hydrophobic (sheds, rather than absorbs, water) and inhibits seedbed germination. This will kill mycorrhizae also which are a specialized soil fungi that serve as extensions of a plant's root system and aids the plant by performing a major role in the uptake of nutrients and water. Mycorrhizae assist planted seedlings in surviving and developing to their fullest potential. With time the soil strucutre will break down after cementation and become more hospitable to vegetation and absorb water again, usually after a year or so, but productivity may be altered for a much greater period of time.

As the demand for forest products continues to grow and as the acreage available for commercial forestry continues to shrink due to special habitat needs and land use restrictions, it is inevitable that forest management practices will need to intensify. **Care will be needed to maintain or improve site productivity** on areas designated for commercial wood production:

1. **Carefully conduct harvesting and reforestation practices:**
   - a. Utilize proper harvesting procedures;
   - b. Implement adequate and appropriate site preparation;
   - c. Promptly reforest following harvest and site preparation;
   - d. Use vigorous, well-adapted genotypes for reforestation;
   - e. Carefully plant or seed;
   - f. Protect stock from pests (insects, big game, rodents), diseases and fire;
   - g. Monitor site productivity, brush competition and conifer survival and growth.

2. **Control competition:**
   - a. Anticipate weed problems before they develop;
   - b. Select appropriate vegetation management strategies;
   - c. Implement correct weed control techniques;
   - d. Monitor treatment results.

3. **Utilize stand management practices:**
   - a. Maintain stocking control (precommercial and commercial thinning);
   - b. Fertilize (natural and artificial);
   - c. Protect from pests (insects, big game, rodents), diseases, fire and physical damage (mechanical damage during thinning).

4. **Monitor, Research and Develop:**
   - a. Refine current technology and information;
   - b. Assist to develop improved silvicultural practices;
   - c. Utilize advances in predictive capabilities and biometrical practices;
   - d. Integrate systems management.

Cutting practices are based upon ecological characteristics of the various species, physical conditions of the site such as slope and potential soil erodability, economic considerations and other specific management objectives for the forest stand. Typical objectives are to direct the productive capacity of the forests to achieve desired combinations of economic and amenity benefits.

A variety of cutting practices have been used in the Big Butte watershed --- from harvesting individual trees with no followup treatments to clearcutting followed by intensive cultural practices, including planting of genetically improved seedlings.

Each regeneration harvest method has advantages and disadvantages that promote or hinder the management objectives for different resources, such as wood production, wildlife, watershed, soil, range and landscape appearance.

~ ~ Paula Trudeau, Silviculturist

The Five Major Regeneration Cutting Methods

Even-aged stands are created through the use of these regeneration harvest cutting methods:

Clearcutting
removes all or most trees in a stand in one harvest, creating an exposed microenvironment suited to the establishment of shade-intolerant species such as ponderosa pine and Douglas-fir.

Seed tree cutting
also best suited to establishment of shade-intolerant species, but provides 4 to 10 seed trees per acre to improve distribution of natural regeneration.

Shelterwood cutting
designed to remove an existing stand in two or more harvests, providing a shaded microsite during establishment of regeneration. This is useful on hot, dry sites, for frost-prone species on frost sites, or to promote more shade-tolerant species such as the true firs. The residual stand may also provide a seed source for natural regeneration.

Uneven-aged stands are created through the use of these regeneration harvest cutting methods:

Individual tree selection
offers maximum site protection and the maintenance of complex vertical stand structure. It tends to promote shaded microenvironments and favor shade-tolerant species. Maintenance of shade-intolerant species will be very difficult by this method. This method requires intensive management to be successful.

Group selection
small, patchy openings that provide the opportunity to promote shade-intolerant species while maintaining the complex horizontal and vertical structure of a stand. Openings are usually about one and a half times the height of the surrounding stand to provide adequate light for the establishment of shade-intolerant species.

Salvage, sanitation, and thinnings are intermediate cuttings. These methods are NOT regeneration harvest methods.

SHADE TOLERANCE OF TREE SPECIES WITHIN THE BIG BUTTE WATERSHED

		SHADE TOLERANCE RATING	
FROST *TOLERANCE*	*INTOLERANT*	*MODERATE*	*HIGH TOLER-ANCE*
HIGH	Lodgepole pine	western white pine Englemann spruce Shasta red fir	mountain hem-lock
MODER-ATE	Jeffrey pine ponderosa pine	noble fir sugar pine incense cedar	Pacific silver fir white fir
LOW	alder	Douglas-fir big-leaf maple	western hem-lock
VERY LOW	Pacific madrone	canyon live oak	---

APPENDIX F

GEOLOGY

I. CHARACTERIZATION

A. GEOLOGY

The Big Butte Watershed can be stratified into **two provinces:**

-- the "softer" **Western Cascade Range** erupted 38 to 17 million years ago, and

-- the "harder" **High Cascade Range** started erupting 7 million years ago.

Though both provinces are volcanic in nature, their physical characteristics and response to forest management are very different.

Western Cascades Geologic Province

The **Western Cascade Range** makes up the western two-thirds of the entire Big Butte Watershed. However on the Forest Service portion of this study the Western Cascades terrane occur as islands of land surrounded by High Cascades terrane. 60% of these rocks are pyroclastics, which easily weather to clay-rich soils. The rocks are soft and often highly weathered. Slopes are often very steep and soils are highly erosive. The Western Cascades terrane is the most unstable rocktype on this Watershed, with respects to slope stability.

High Cascades Geologic Province

The **High Cascade Range** occupies the area east of the Western Cascades. It consists of two distinct types and time periods of volcanic eruptions;

-- **shield volcanos** which erupted **basalt** lava 7-to-3 million years ago;

-- **composite volcanos** which started erupting **andesite** lava 3 million years ago.

The base of the High Cascades rests upon the Western Cascades and is built up from a chain of broad, overlapping **shield volcanos** that erupted seven-to-three million years ago. The shield volcanos are not considered active.

About three million years ago erupted-lava changed from basalt to andesite. Unlike the very liquid basalt lava of shield volcanos, which builds broad slightly domed shield volcanos, andesite lava is much thicker and builds up into prominent peaks called composite volcanos, like Mt McLoughlin. Mt. McLoughlin is a composite volcano built on top of an older shield volcano. The western edge of one of these shield volcanos protrudes from beneath the northwest margin of Mt. McLoughlin. The composite volcanos are still considered capable of erupting.

THE ICE AGE

The Ice Age began two million years ago and had a profound effect on the modern landscape and biotic communities adjacent to the Cascades Range. During the Ice Age a nearly continuous ice field capped the High Cascades from Mt. Hood near the Columbia River, to Mt McLoughlin. Mt. McLoughlin was 1,000 feet taller before being eroded by glaciers.

The natural processes during this period of rapid erosion included large periodic influxes of sediment and logs which temporarily inundated streams and rivers. Subsequent floods moved the sediment through the system and eventually to the ocean. The sand quarry near Oden and Fish Lake roads is an example of glacial outwash. Aquatic life evolved in this dynamic environment and adapted to these processes.

The last major glacial advance in the Cascade Mountains reached its peak about 20,000 years ago. An important aspect of the last glacial advance is that the oldest dated human occupied sites in North America coincide with this period.

By 10,000 years ago, the glaciers of the Southern Cascades had disappeared, and the warm dry climate of the Holocene Epoch began. This warm period reached its peak about 8,000 years ago. Since this time, Earth's average temperature has decreased.

This decrease in average temperature over the last 8,000 years has been cyclical, not continuous. The most recent of these cycles is referred to as The Little Ice Age, which lasted from about 1350 to 1870 A.D. During this period winters were colder, summers were cooler and precipitation was greater. The cooler summers inhibited cultivation of crops and strongly influenced pre-industrial society. Many of the older stands of trees on the RRNF started growth under these cooler, moister conditions.

KEY PROCESSES and FUNCTIONS

A. GEOLOGY

Municipal Watershed

One of the outstanding features of this watershed is the 26 million gallon per day Big Butte Springs complex. This system has been developed as the municipal water source for the City of Medford. Water from this system of springs is of exceptional quality.

A soil infiltration study was done in conjunction with the Big Butte Springs Watershed Geohydrologic Report (1990). The study revealed that two-thirds of the Watershed has surface infiltration rates between 3 and greater that 24 inches per hour. High infiltration rates, like these, clearly indicate the potential for pollution of the spring system. Plate III of the 1990 study (Groundwater Hazard Zonation) delineates hazard ratings of high to low infiltration rates relative to potential damage to the municipal water source.

Slope Stability

The primary mass-wasting processes in the Big Butte Watershed are from raveling on steep slopes, earthflows in clay rich soils and debris slides in or near steep drainages are the primary mass-wasting processes at work.

Ravel is found in patches throughout the Big Butte Watershed. This steady downhill movement of soil and rock debris deposits material in or near draws and streams. As deposits thicken on steep slopes they become unstable.

Earthflows and debris slides on the Watershed are primarily confined to the rocks of the Western Cascades and area surrounding Oak Mountain.

Rocks of the Western Cascades weather to clay-dominated soils. Clay has great moisture holding capability and also is cohesive. As these clay-rich soils become thick (10 to 100 feet thick) and heavy with moisture, gravity often causes them to ooze slowly downhill as a type of landslide called an **earthflow**.

Sediment from earthflows typically has a high silt and clay content. In the Watershed most of the Western Cascades are in the headwaters of Willow Lake. The colloidal nature of clays from the Western Cascades is responsible for the turbid water of this reservoir, and the Ash, Indian and Biederstedt Creeks.

When compacted the small size and attraction of clay particles tightly fill the spaces between all other soil components, resulting in a nearly solid mass that may not let air and water pass through.

Once compacted it is nearly impossible to return clay soils to an noncompacted state. Tilling compacted clay-rich soil breaks the soil into clods that when wet flow back into a semisolid mass.

Functions of Unstable Terrain

Unstable terrain (earthflows, rock falls, debris slides) provide and maintain habitat for a variety of species (salamanders, frogs, marmots, bats, etc.)

-- Refresh the supply of gravels available for fish habitat needs.

-- Supply large woody material from intermittent streams to fish-bearing streams.

-- Moisture sinks, upslope pockets of moist ground that retain moisture longer.

-- Produce large woody material by pushing over and toppling trees.

-- Churning of duff into the lower A and B soil horizons that in an uncompacted state often produces a land type that grows trees well.

Seismicity

The Watershed was shaken in 1993 by two moderately large earthquakes (about 6.0 magnitude), which occurred near Klamath Falls. More quakes of this size should periodically be expected.

The Watershed is traversed by the Mt. McLoughlin Fault Zone, a series of sub-parallel faults. The majority of this zone is about six miles wide, extending through the Cascades on a line including Pelican Butte and Oak Mountain. This Zone has not moved in modern times, but should still be considered active.

The South Fork of Four Bit Creek follows one of the faults associated with this zone. Fractured rock below ground may form a conduit allowing water from east of the Cascades (Four Mile Lake) to drain into the watershed, via Four Bit Creek. Wetlands and ponds at the headwaters of Four Bit Creek are a result of this glacial and faulting history.

Recent studies have shown that every 300-to-500 years the entire Pacific Northwest west of the Cascades is shaken by a 9.0 earthquake. A 9.0 quake would shake strongly for 3-5 minutes. Most structures (buildings, pipelines, dams) were built before quakes of this size were known to have occurred in this area. The last great quake of this type occurred 300 years ago. Expected effects to the watershed are unknown.

For a more information on movement of scree, earthflows, debris slides, concerns for clay-rich soils, a listing of ecological influences of unstable terrain and earthquake potential see the Geologic History of the Southern Oregon Cascades, an unpublished report in the appendix to this study.

HISTORIC AND CURRENT CONDITIONS AND TRENDS

A. Geology

Some key concepts relating to geology within the Watershed are:

- the Western Cascades (see plate 1) are the most unstable and erosive rocktypes in the Watershed;
- relatively recent uplift has resulted in slopes that are at times steep;
- ground disturbing activities can impact these steep slopes;
- retention of vegetation in the riparian reserve is needed to impede down-cutting, caused by both recent uplift and increased and concentrated runoff due to timber harvest and roads;
- soils on slopes erode easily if disturbed;
- woody material of all sizes is critical for maintaining surface stability;
- gully erosion has occurred where runoff has concentrated in channels;
- soil organic matter is slow to accumulate;
- removal of litter by burning or forest management practices accelerates the erosion of soil and rock particles on steep slopes;
- many trees growing on sparsely vegetated south facing slopes and ridge tops started growing during the Little Ice Age (1350-to-1870 AD), a period when average temperatures were cooler and precipitation was greater;
- south exposures or aspects are very slow to recover from burning or any other management practices;
- reactivation of ancient landslides could occur through improper road and culvert location and, in some instances, by activities that too intensely disturb the soil;
- clear cut timber harvesting has exacerbated instability by loss of root strength and increasing groundwater available to unstable terrain;
- road building intercepts groundwater and sometimes concentrates the water into areas that can saturate soils and weathered bedrock, increasing the likelihood of slope failures.

FUTURE TRENDS IN SOILS AND GEOLOGY

- Southern Oregon has been in a drought for eight of the last nine years which has helped slopes stabilize. However, when moist conditions return, soils could develop a short-term increase in erosion and landslide potential.
- It is likely that problems associated with soil ravel and compaction may continue for some time as delayed affects of harvest methods continue to accrue.
- If soil displacing activities continue into the future then these problems may continue to increase in severity.
- These affects will decrease as results of ongoing rehabilitation projects progress.

DESIRED RANGE FUTURE CONDITIONS

A. GEOLOGY

- -- The Watershed would continue to be a high quality municipal water source;
- -- soil would be at its productive potential and handles precipitation without eroding the surface or resulting in cumulative effects off-site;
- -- compaction and displacement would be minimized on clay rich and wet soils;
- -- management activities would avoid reactivation of ancient landslides;
- -- monitoring would be done for past, current and future effects on soils for all types of activities;
- -- site-specific restoration projects would be developed for adversely impacted soils;
- -- priority would be given to project level work that inventories intermittent streams for rehabilitation opportunities;
- -- projects would be designed to maintain or restore soil productivity;
- -- mitigation measures for soil impacting activities would be developed and monitored;
- -- adversely impacted lands would be restored;
- -- road surfaces and drainage structures would produce minimal erosion;
- -- unstable lands near riparian zones would produce minimal erosion;
- -- federally managed roads that are not needed would be obliterated; and
- -- slope stability mapping and soil resources inventory updates would be done prior to any activities.

RECOMMENDATIONS

A. GEOLOGY

-- Continue to protect the municipal watershed by following the mitigation procedures outlined in Chapter 8 of the Big Butte Springs Geohydrologic Report;
-- minimize compaction on clay-rich and wet soils;
-- avoid reactivation of ancient landslides;
-- monitor for past, current and future effects on soils for all types of activities;
-- develop site-specific restoration projects for adversely impacted soils;
-- design new projects to maintain soil productivity;
-- develop and monitor new mitigation measures for activities;
-- inventory intermittent streams for rehabilitation opportunities;
-- armor existing and planned road surfaces and drainage structures on sensitive soils and/or unstable lands;
-- rehabilitate unstable lands near riparian zones;
-- close federally managed roads that are not needed;
-- update soils resources inventory and slope stability mapping prior to implementation of any project;
-- improve frequency and long-term recruitment of LWM; and
-- consider re-growth potential before projects on south-facing droughty soils.

APPENDIX G

FIRE MANAGEMENT

BIG BUTTE WATERSHED
Fire Management Report

Introduction

Fire is a disturbance mechanism that has shaped vegetation succession within the Big Butte Watershed. This water shed supplies high quality domestic water to over 100,000 persons. Fire must be considered when managing this area in order to protect this water source. This paper will identify fire hazard areas as well as those of high risk based on historical fire occurance, topography, climate, and fire behavior patterns. These outputs should form the basis for future management actions within this watershed. Fire is also a management tool. Sivicultural, wildlife, timber, water and vegetation management objectives can be accomplished through its use within the Big Butte Watershed.

Historic Fire Environment

Prior to 1900--Before Organized Fire Suppression

Low Elevation

Low intensity fires both lightning caused and those set by Native Americans burned periodically throughout the summer and early autumn within this watershed. Native Americans used fire as a tool for hunting and maintenance of Huckleberry fields. Fires burned every 15 to 30 years mainly along the ground rather than in tree crowns. These fires perpetuated the open park like Ponderosa and Sugar Pine stands dominating the landscape near and around Fourbit Creek. Due to fire frequency fuels were consumed leaving what can be described as light loading of needles and small limbs. Small amounts of large woody material were present on the forest floor. Low volume of fuel accumulation did not create conditions favorable for stand replacement fires. Fire as a disturbance mechanism was not as catastrophic during this time period as is today because of fire exclusion and resulting fuels buildup.

High Elevation

Fire severity is more varied at higher elevations due to more moisture and shorter growing seasons. Low intensity ground fires along with high intensity crown (stand replacement) fires occured. These fires produced a mosaiac forest of various ages and densities. Fuels were generally heavier than low elevation due to lack of consumption from frequent ground fires. Forests were more resistant to insects and disease than the dense stands that dominate these sites today.

After 1900--Age of Fire Suppression

All Elevations

Settlement brought about fire suppression to protect homesteads, grazing lands and timber resources. Fire frequency decreased dramatically however the Cat Hill fire of 1910 was a stand replacement event totaling about 30,000 acres. This fire occurred in the north eastern side of the watershed and extended from the flats around Whiskey Springs into the current Sky Lakes Wilderness Area.

Severity of this fire is evidenced by historical accounts of Forest Suprevisor Erickson and several companions being trapped behind the flames. They had to "submerge themselves in one of the Twin Ponds to keep from being roasted" (Beeman 1954:3). Even with the advent of suppression dry climatic conditions favored these large stand replacement fires. The South Fork fire of 1915 just north of this watershed is testimony to conditions conducive to large devastating fires of this decade. Suppression has been effective on the low intensity ground fires thus large quantities of aerial or "ladder" fuels have built up.

Climate/Weather Events

The summertime weather pattern is dominated by the Pacific high pressure. The Pacific high pressure cell moves from its southern wintertime position and migrates into the northern Pacific during the summer months. This Pacific high forces moisture laden storms to the north of interior southwest Oregon which results in hot dry summers. Precipitation within the Big Butte Watershed ranges from 40 to 80 inches per year with 70% occuring in the November through May time period. Summertime moisture is limited to occasional thunderstorms. Sixty to ninety days can elapse without measurable precipitation. Fire season temperatures range from an average high of 70 degrees in June to 85 degrees in August. Maximum temperatures reach 100 degrees with many days in the mid to high 90's. The potential exists for large stand replacement fires when drought coupled with high temperatures and windy conditions exist. Another critical weather pattern that occurs from mid to late September is that of an East Wind event. These winds will funnel around Mt McLoughlin and blow from east to west across the watershed. Velocities reach 50 to 60 miles per hour.

Fuels and Vegetation

Currently understory brush with mixed conifer overstory dominate the Cat Hill fire area while young mixed conifer stands are prevelent over the portion of area classed as managed watershed. True fir/Hemlock forests exist at higher elevations. Logging and sivicultural treatments along with hazard reduction measures have contributed to early seral stage stand development at lower elevations. This vegetation condition is susceptible to stand replacement fire due to understory brush acting as ladder fuel for carrying fire to the relatively low crowns of these young conifers. Higher elevations areas are designated as wilderness under the forest plan. Fire exclusion within this wilderness portion has contributed to fuel buildup. The slopes of Mt. McLoughlin contain extensive lava fields dominated by brush with scattered timber in draws and on north slopes.

Fire Potential

Fire Risk and Fire Hazard will be combined to asses fire potential within this watershed. Fire risk will be based on fire occurance records from 1960 to 1992, while fire hazard is determined through fire behavior predictions.

Fire Risk

Fire Risk is defined as the chance of a fire occuring that threatens life, property or valuable resources. Risk is determined by a numerical analysis of post fire occurance. Fire records for the Butte Falls Ranger District, specific to the Big Butte Springs Watershed for the 1960 through 1992 were plotted. A risk assesment was made based on the 70 fires that occurred within this time frame and geographical area. There were 42 lightning fires and 28 mancaused. Mancaused fires consisted of 2 arson, 5 smoking, 3 equipment, 4 campfire, 2 debris burning and 12 miscellaneous. A fire occurance zone map was developed by plotting these fire locations. Zones were classified as either high, medium or low occurance . The low zone had 30 fires, while the medium and high contained 25 and 15 fires respectfully. Keep in mind, these zones are delineated by fire density and determined by zone size not just number of fires. For example the low zone had 30 fires compared to 15 for the high zone but the low zone has an area of 34,818 acres while the high zone includes an area of 5,403 acres.

The risk numerical rating was determined using the following formula:
$(x/y)10/z=$ rating

where
- x - number of starts for area
- y - period of time records cover (1960-1992,32yrs)
- z - acres within zone

Fire frequency and Risk Rating for each occurance zone.

Risk Zone	acres	# of fires	Freq	Risk # Rating
Low	34818	30	.94	.27
Medium	16212	25	.78	.49
High	5403	15	.47	.86

Keep in mind the risk rating of low, medium, high are determined by comparison of fire occurance within this watershed only. Frequency represents number of fires per year within that zone. For example we can expect .94 fires per year in the low zone, .78 fires per year in the medium zone and .47 fires per year in the high zone. Based on 32 years of data this equals to 2.19 fires per year over the entire watershed. Again, these are averages for the watershed. There may be some years that no fires occur and others with multiple starts. Low risk zone rating of .27 equates to .27 fires per 10 year period per 1,000 acres. So we can expect .27 fires per ten year period on any given 1,000 acres. This rating is .49 and .86 respectfully for medium and high zones. See map of risk zones attached.

Fire Hazard

Fire hazard is measured through fire behavior characteristics that define the degree of difficulty in stopping and holding a fire. The two fire behavior characteristics that effect our ability to stop and hold fire are flame length and rate of spread. These are generally classified as either low, moderate or high based on fire behavior outputs from the Behave Fire Behavior Prediction and Fuel Modeling System. Below is a description of each level.

Low: Flame lengths <4' - Fires can generally be attacked at the head or flanks by persons using handtools. Handline should hold the fire.

Moderate: Flame lengths 4-8' - Fires are to intense for direct attack on the head by persons using handtools. Handline cannot be relied on to hold fire. Equipment such as dozers, pumpers, and retardent aircraft can be effective.

High: Flame lengths >8' - Fires may present serious control problems, such as torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.

As shown in these ratings flame length is used to determined the level. However a fast moving fire can occur in some fuel models such as grass with low flame lengths.

Hazard Ratings were determined by combining fuel models, weather and topography to produce a fire behavior prediction for all areas of the watershed.
*Fuel Models were computer generated using vegetation condition contianed in the Geographical Information System data base. These vegetation conditions were developed by the district siviculturalist. Northern Forest Fire Labratory Fuel Models were used.
*Topography - Slope aspect and elevation effect fire behavior,steep south facing slopes have greatest potential. Using the GIS system this watershed was mapped using the following topographic characterics.
Aspects - N,NE,E,SE,S,SW,W,NW
Slope% - 0-34, 35-65,and 65+.
*Weather -Weather parameters of wind, temp and humidity observed at the Big Butte Raws Station were used to determine fuel moistures for fire behavior outputs.

Behave runs were made on a landscape basis using slope and fuel models generated by the GIS system. Aspect was not used in this process due to variability over the entire watershed, but should be used when planning on a project level basis. Behave outputs show there are 35,218 acres of low hazard, 3,378 acres of moderate hazard and 3089 acres of high hazard.
See hazard map attached.

In order to asses fire potential on this watershed fire risk (occurance) and fire hazard (behavior) were combined to produce a map (see appendix) showing the following:

	Acres
Low hazard - Low Risk	18,769
Low hazard - Med Risk	13,251
Low hazard - High Risk	3,198
Medium hazard - Low Risk	2,330
Medium hazard - Med Risk	791
Medium hazard - High Risk	257
High hazard -Low Risk	0
High hazard - Med Risk	0
High hazard - High Risk	0

*See Hazard and Risk Map attached.

This watershed does not include areas of high hazard and high risk due to general gentle slopes, however a catastrophic stand replacement fire could occur when the right combination of conditions (drought in combination with a wind event) exist as evidenced by the Cat Hill fire of 1910. It is unknown what effect a large fire of this magnitude would have on water quatlity at the Big Butte Springs but is of concern to the Medford Water Commission.

Recommendation

Zones identified as high hazard and high risk should receive top priority for treatment. However, other resources should be considered in our planning . This watershed produces domestic water and is the prime objective for management. A portion also classed as matrix under the Presidents forest plan requires commodity production. Vegetation and stand conditions must remain healthy in order to meet these objectives. Fire applied under the correct conditions is a necessary tool to maintain this health and can be used to enhance wildlife forage, reduce buildup of fuels, and control stand density. Many of the stands at lower elevations are favorable for underburning in conjunction with thinning. Favor application of fire over ground based treatment methods such as machine piling to minimize compaction and duff removal. This treatment combination meets forest health needs as well as commodity production. Reintroduce fire to reduce natural fuel accumulations, maintain desired stand density and improve forest health. Two areas to consider when applying fire in this watershed are:

- *How does burning effect water quality in the Willow Creek drainage where surface runoff is the major water contributor.
- *How does burning effect water quality in the Red Zone (Zone of high infiltration rates).

Fire should be allowed to play its natural role within the Skylakes Wilderness Area based on an approved Fire Management Plan yet to be developed.

Future considerations

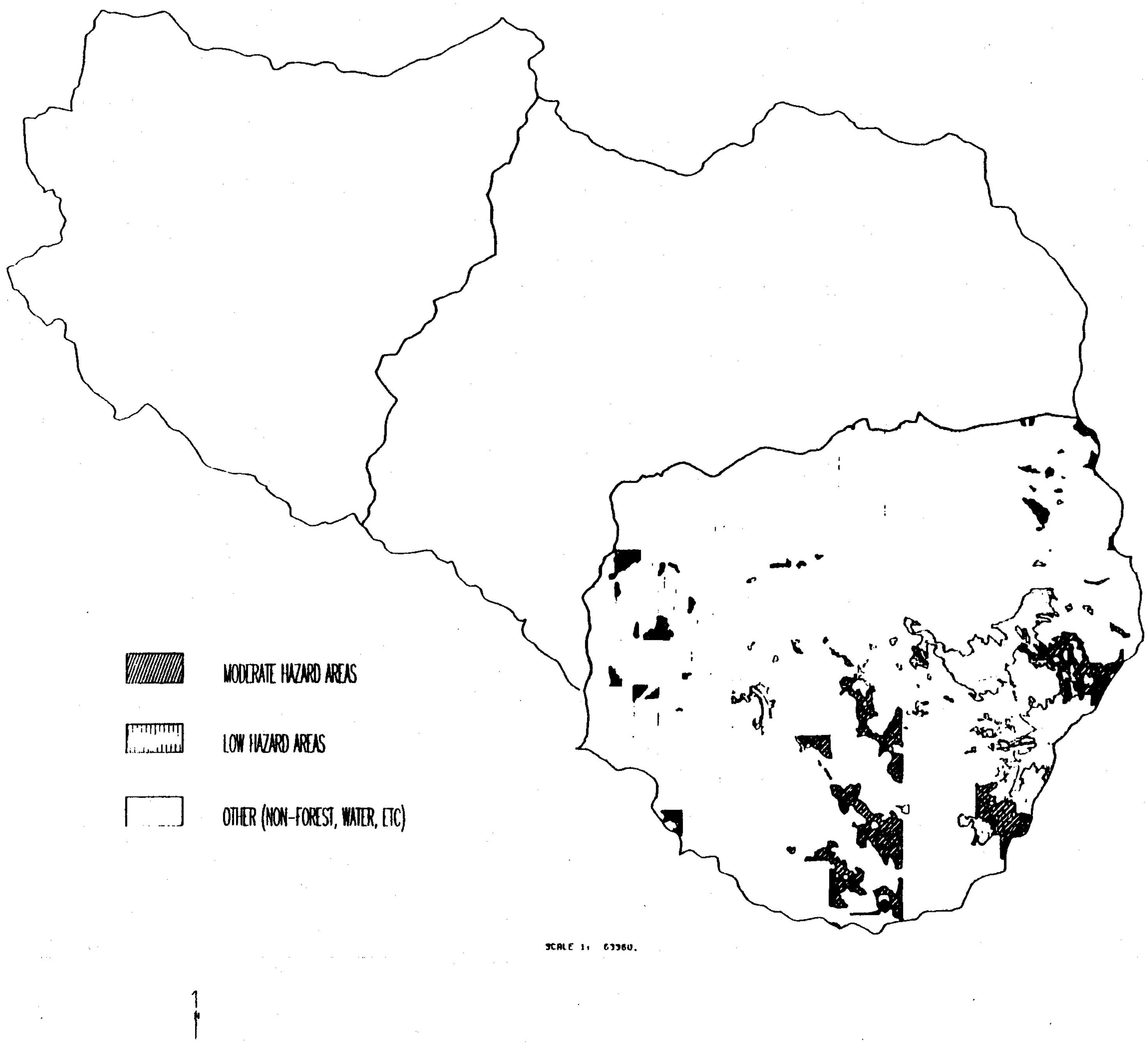
:Verify fuel models - These were computer generated based on vegetation conditions. These need verified based on fire behavior considerations.

:Maintian protection programs and resources. Protection to consist of maintenance of facilities such as Helispots, water sources, and fuel breaks. Maintain suppression crew capability and deliver prevention messages through recreation opportunities at Willow Lake, Fourbit, Snowshoe, Whiskey Springs and Willow Praire Campgrounds.

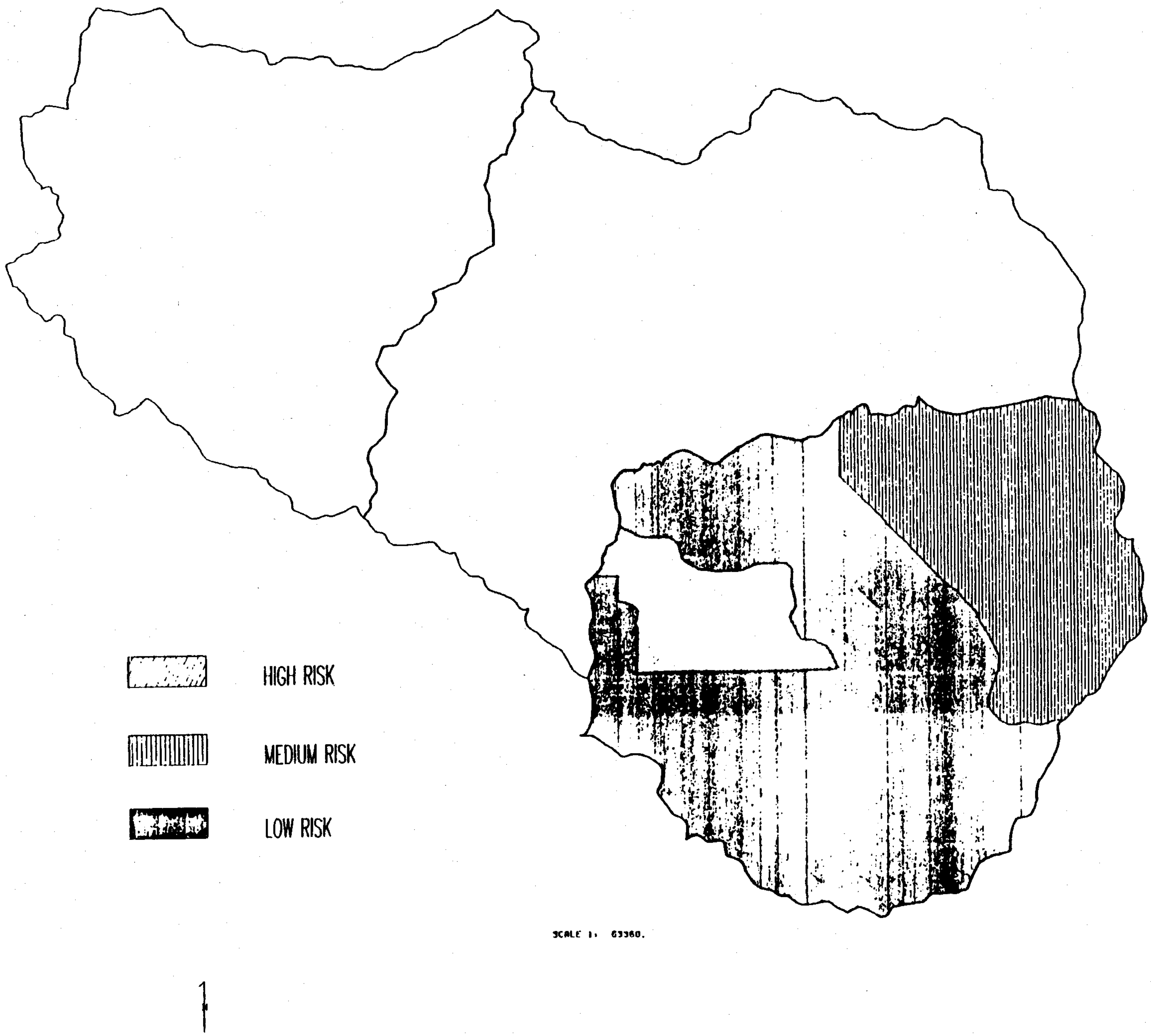
:Smoke Management- Reintroduction of fire will increase smoke production within this area. Human health effects of smoke are of concern. Burning should be done using rapid ignition methods to minimize production of particulates and during meteorlogical conditions that favor good dispersal. Periodic burning will reduce particulate production during a wildfire event.

:Maintain area in a low fire hazard condition where fires could be controlled using personnel with hand tools (flame lengths less than 4')

FIRE HAZARD ZONES ' ? BIG BUTTE WATERSHED



FIRE RISK ZONES FC 3IG BUTTE WATERSHED



FIRE HAZARD/RISK ZON' FOR BIG BUTTE WATERSHED